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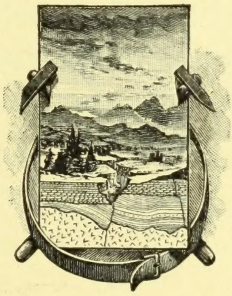
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPERS

Nos. 245-249



WASHINGTON
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CONTENTS

Water-supply paper 245; Surface water supply of United States, 1907–08, pt. 5, Upper Mississippi River and Hudson Bay basins.

Same 246; Surface water supply of United States, 1907–08, pt. 6, Missouri River basin.

Same 247; Surface water supply of United States, 1907–08, pt. 7, Lower Mississippi basin.

Same 248; Surface water supply of United States, 1907–08, pt. 8, Western Gulf of Mexico.

Same 249; Surface water supply of United States, 1907–08, pt. 9, Colorado River basin.

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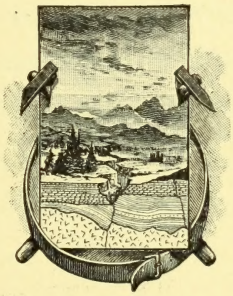

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 245

SURFACE WATER SUPPLY OF THE UNITED STATES

1907–8

PART V. UPPER MISSISSIPPI RIVER AND HUDSON BAY BASINS

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

A. H. HORTON, E. F. CHANDLER
AND R. H. BOLSTER

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SURFACE WATER SUPPLY OF THE UPPER MISSISSIPPI RIVER AND HUDSON BAY BASINS, 1907–8.

By A. H. Horton, E. F. Chandler, and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country.

These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named, this use of water, nevertheless, has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly produc-

tive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
III	243	Ohio River basin.	VIII	248	Western Gulf of Mexico.
IV	244	St. Lawrence River basin.	IX	249	Colorado River basin.
V	245	Upper Mississippi River and Hudson Bay basins.	X	250	Great Basin.
			XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.= Annual Report; B.= Bulletin; W. S.= Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1881 to Sept., 1890.
12th Ann., pt. 2	....do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	....do	1903.
W. S. 124 to 135	....do	1904.
W. S. 165 to 178	....do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907–8.
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65,75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47,(48)	65,75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65,75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35),36	48	65,75	(82),83	(97),98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65,75	83	98	127	168	204	242
St. Lawrence River	36	49	65,75	(82),83	97	129	170	206	244
Hudson Bay	.....	.....	66,75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48,(49)	65,75	83	98	128	169	205	243
Upper Mississippi River	36	49	65,75	83	98,(99)	128, (130)	171	207	245
Missouri River	(36),37	49,(50)	66,75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66,75	(83),84	(98),99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66,75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37),38	50	66,75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66,75	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66,75	85	100	134	177	213	251
North Pacific coast	38	51	66,75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the

basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit, from which others are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States galoons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.

1½ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ —net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 13, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of

sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200[a]) and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The editions of both of these water-supply papers are practically exhausted. They can, however, be consulted at most of the larger libraries of the country or they can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents for No. 180 and 35 cents for No. 200. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

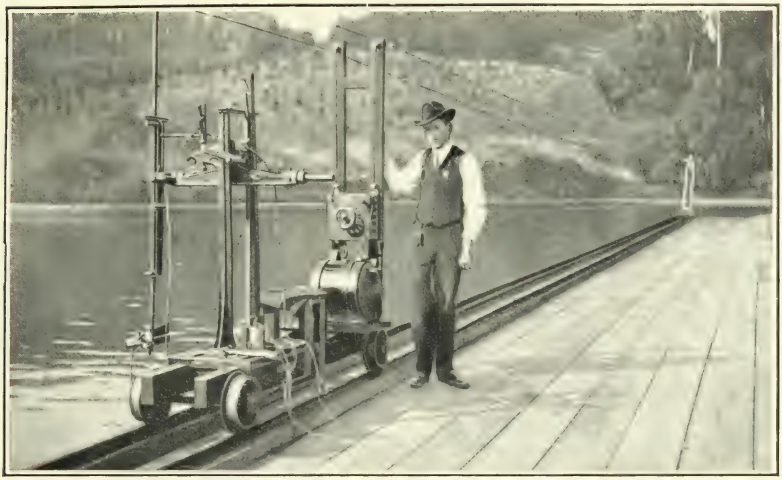
Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years, unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent, or less, of the total width, will within reasonable limits yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible stations are located where the banks are high and not subject to overflow at high stages, and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth of the section at the time of measurement.

The measuring points divide the total cross section into elementary strips, at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0.8 depth method.

discharge of the stream. (For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method with its various modifications of surface, subsurface, and tube or rod floats is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared

which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

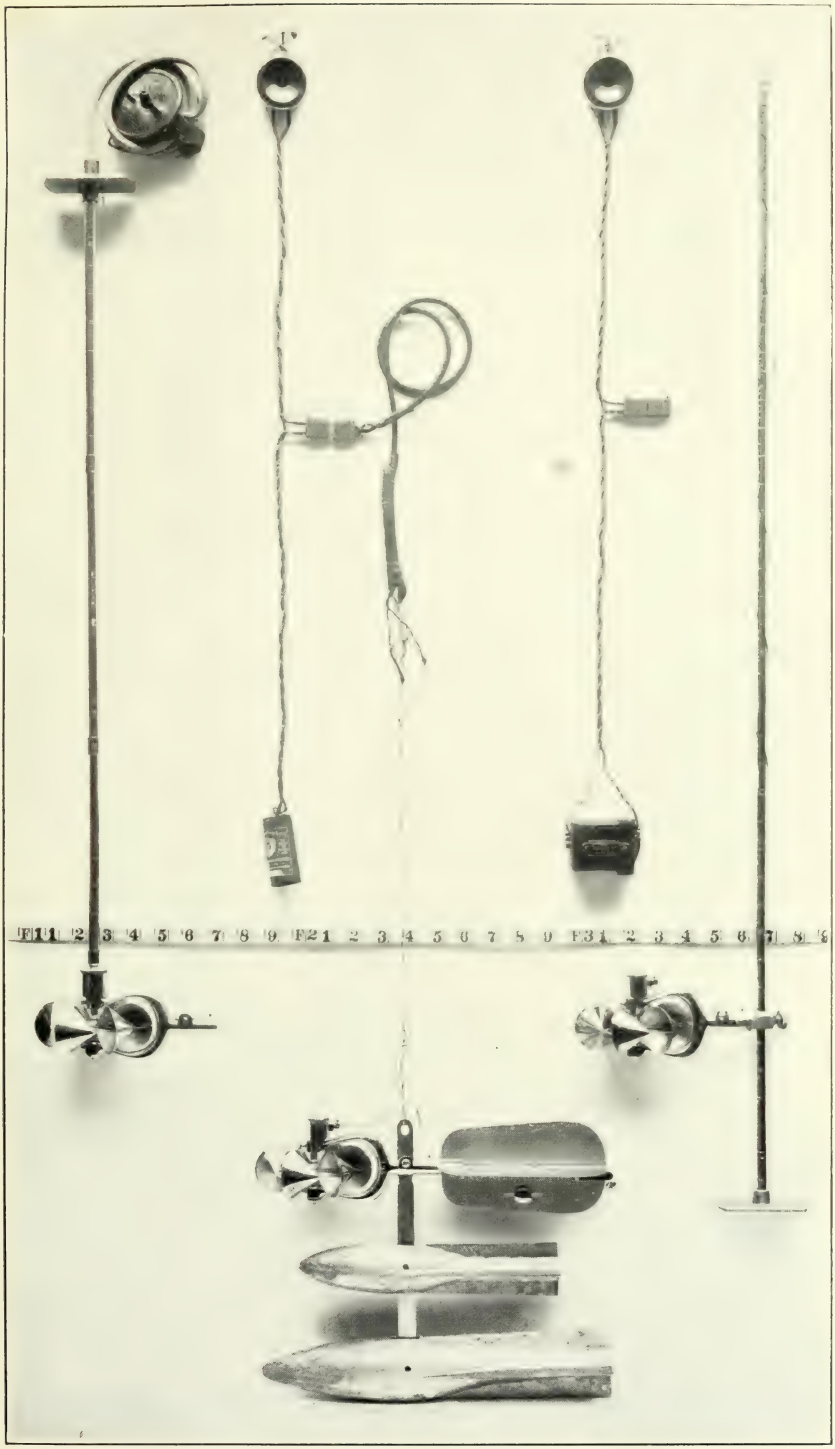
The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. 1, *B*.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average



PRICE PENTA-RECORDING CURRENT METERS.

coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater that in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and

from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see figure 1 and Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are as a rule comparatively permanent during low and medium stages and when the flow is sufficiently well defined by an adequate number of discharge

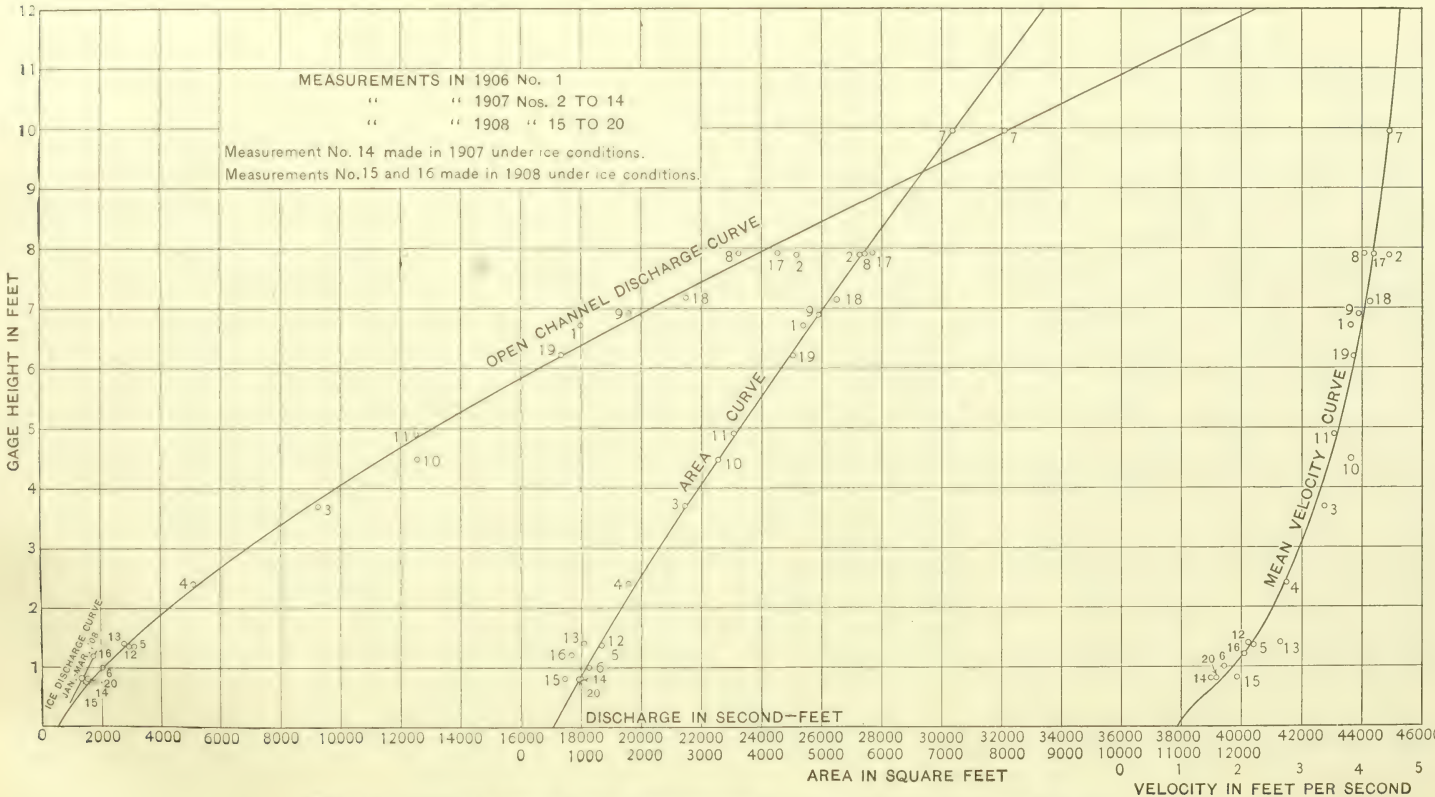


FIGURE 1.—Discharge, area, and mean velocity curves for Chippewa River at Chippewa Falls, Wis.

measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. For illustrative examples of stations of this type see Water-Supply Paper 246.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. (See fig. 1.) If sufficient measurements could be made at stations of this class, results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semi-permanent and shifting channels. It is not absolutely correct but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either

reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is

assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abandoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can alone dictate the course to pursue in such cases. For illustrative examples of a station of this type, showing the Bolster method of determining the daily discharge graphically, see Water-Supply Papers 247 and 249.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed, even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous

tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly discharge table. In the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate" within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer

who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

Assistance has been rendered or records furnished by the following to whom special acknowledgment is due: United States Weather Bureau, United States Reclamation Service, Wisconsin Valley Improvement Company, Great Northern Development Company, and Mr. Frank Dearborn. The State of Illinois cooperates in the stream gaging work being done in that State, the appropriation being under the control of the Internal Improvement Commission, Mr. Isham Randolph, chairman.

DIVISION OF WORK.

The field data for the upper Mississippi River drainage were collected under the direction of L. S. Smith, A. H. Horton, and J. C. Hoyt, assisted by G. A. Gray, R. J. Taylor, and Wm. M. O'Neill.

The field data for the Hudson Bay drainages were collected under the direction of J. E. Stewart, district engineer, assisted by E. F. Chandler, A. F. Huch, and J. B. Pierson.

The ratings, special estimates and studies of the completed data were made by A. H. Horton, R. H. Bolster, Robert Follansbee, and E. F. Chandler.

The computations and preparation of the completed data for publication were made under the direction of R. H. Bolster, assistant engineer, assisted by Robert Follansbee, G. C. Stevens, H. D. Padgett, R. C. Rice, J. G. Mathers, and M. I. Walters. The entire report was edited by Mrs. B. D. Wood.

HUDSON BAY DRAINAGE.

GENERAL FEATURES.

All the waters that reach Hudson Bay from the United States pass through Lake Winnipeg and thence into the bay through Nelson River. The two principal tributaries of Lake Winnipeg, and thus, indirectly, of Nelson River, are the Saskatchewan and Red River. The Saskatchewan drains the major portions of the provinces of Alberta and Saskatchewan and the northwestern part of Assiniboia, in the Dominion of Canada, and, through St. Mary River, a small area in northwestern Montana in the United States. Red River drains a large basin in the United States, covering portions of Minnesota and North and South Dakota. Both rivers are large and important.

ST. MARY RIVER DRAINAGE BASIN.

DESCRIPTION.

St. Mary River heads in northern Montana, near the Canadian boundary line, on the eastern slope of the main range of the Rocky Mountains, in a region of perpetual snow, and in the midst of numerous glaciers. It starts from the great Blackfoot Glacier, probably the largest in the Rocky Mountains within the United States, and receives affluents from at least a dozen lesser glaciers. These small streams unite within a short distance from their source and flow into a lake hemmed in by high mountains known as Upper St. Mary Lake Below this lake, and separated from it by a narrow strip of land, is Lower St. Mary Lake. The aggregate length of these two lakes is about 22 miles. The river flows out of the lower lake, the elevation of which is 4,460 feet above sea level, and within 2 miles is joined by Swiftcurrent Creek, which is fed by waters of Grinnell Glacier and four small glaciers. From the confluence of these streams to the international boundary, a distance of 12 miles, the St. Mary flows in a northerly direction, receiving Kennedy Creek a few miles before crossing the boundary. Entering the province of Alberta it empties into Belly River, its waters eventually finding their way through the Saskatchewan into Hudson Bay.

That portion of the drainage area below the region of glaciers has a heavy forest covering, consisting of spruce and fir timber on the higher slopes, and a dense growth of willows and aspen on the lower portions.

The mean annual rainfall is about 60 inches, of which the greater part occurs in the form of snow during the winter months. The altitude of the drainage basin within the United States ranges from 4,000 feet to 10,000 feet.

The only diversion from the St. Mary in the United States is that which is being made by the U. S. Reclamation Service in connection

with the Milk River project. It is proposed to reservoir Lower St. Mary Lake and divert 850 second-feet of water into the Milk River drainage basin. Both Upper and Lower St. Mary lakes can be made into storage reservoirs. A view of St. Mary canal and dam near Kimball, Alberta, is shown in Plate III, *A*. Water-power possibilities are not important in the basin as the many small streams which form the river are frozen over during the winter months.

The following gaging stations have been maintained in this drainage basin:

St. Mary River at Main, Mont., 1901–1902.
St. Mary River near Babb (formerly Dam Site), Mont., 1902–1908.
St. Mary River near Cardston, Alberta, 1902–1908.
Swiftcurrent Creek near Babb (formerly Wetzel), Mont., 1902–1908.
Kennedy Creek near Babb (formerly Wetzel), Mont., 1903–1906.

ST. MARY RIVER NEAR BABB, MONT.

This station, which was established April 9, 1902, for the purpose of securing run-off data in connection with irrigation projects on the Blackfoot Indian Reservation and in the Milk River Valley, is located about 4,500 feet below Lower St. Mary Lake, and about 2,500 feet above the mouth of Swiftcurrent Creek, the nearest tributary. The run-off at this point is that from Upper and Lower St. Mary lakes. The drainage area is 177 square miles. There is no diversion above the station. The United States Reclamation Service has appropriated 850 second-feet of water from this stream which will be diverted near the station. A reservoir will also be formed at Lower St. Mary Lake.

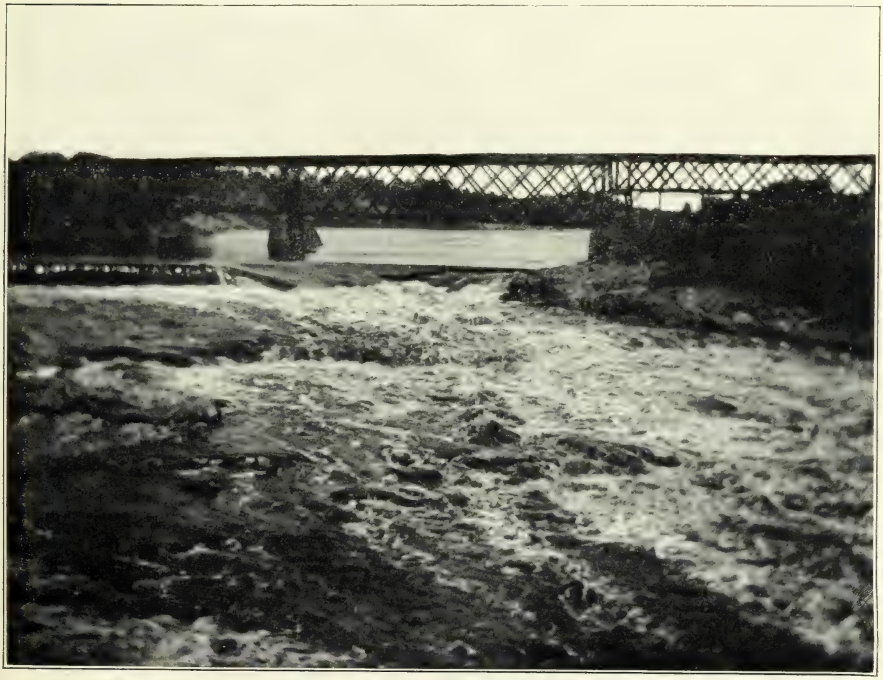
The datum of the gage has remained constant since the station has been established. The records at this station are excellent except during the winter months, when ice conditions affect the results.

Discharge measurements of St. Mary River near Babb, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 20	W. S. Hanna		72	1.75	167
March 30[a]	do		75	1.65	162
May 14	J. E. Stewart	95	184	3.05	691
June 5	J. B. Pierson	106	369	4.88	2,230
July 1	do	106	432	5.60	3,010
August 7	do	95	245	3.58	1,120
September 6	Follansbee and Pierson	90	192	3.11	761
1908.					
April 17	A. F. Huch	76	85	1.85	171
June 19	do	110	419	4.84	3,140
July 25	Stewart and Huch	95	230	3.30	1,020
August 21	do	80	136	2.17	525
August 22[b]	do	165	197	2.17	501
October 8[c]	A. F. Huch	65	130	1.49	199

[a] Snowdrift in stream at left bank.
[b] Wading measurement, above the gage.
[c] Wading measurement, one-fourth mile below the gage.

A. ST. MARY CANAL AND DAM NEAR KIMBALL, ALBERTA.



B. DAM AT BLACK RIVER FALLS, WIS., PARTLY CARRIED AWAY BY HIGH WATER.

Daily gage height, in feet, of St. Mary River near Babb, Mont., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				1.7	2.4	3.9	5.6	.....	3.3	2.7	1.9	1.5
2				1.7	2.4	4.0	5.5	.....	3.2	2.7	1.9	1.5
3				1.7	2.4	4.2	5.5	.....	3.2	2.7	1.9	1.5
4				1.7	2.4	4.5	5.5	.....	3.2	2.7	1.8	1.5
5				1.7	2.4	4.7	5.5	.....	3.1	2.6	1.8	1.5
6				1.7	2.4	4.9	5.5	.....	3.1	2.5	1.8	1.5
7				1.7	2.5	5.1	5.4	3.6	3.1	2.5	1.8	1.5
8				1.7	2.5	5.1	5.3	.....	3.1	2.5	1.8	1.5
9				1.7	2.5	5.0	5.2	.....	3.1	2.5	1.7	1.5
10				1.8	2.5	4.8	5.2	.....	3.0	2.4	1.7	1.5
11				1.8	2.5	4.8	5.1	3.3	3.1	2.4	1.7	1.5
12				1.8	2.6	4.8	5.0	3.3	3.2	2.3	1.7	1.5
13				1.8	2.9	4.9	4.8	3.3	3.2	2.3	1.7	1.5
14				1.9	3.0	4.9	4.8	3.2	3.0	2.3	1.7	1.5
15				1.9	3.2	4.9	4.7	3.2	2.9	2.3	1.7	1.5
16				1.9	3.7	5.0	4.7	3.2	2.9	2.3	1.6	1.5
17				2.0	4.0	5.0	4.6	3.1	2.9	2.2	1.6	1.3
18				2.0	4.3	5.1	4.5	3.1	2.9	2.2	1.6	1.3
19				2.0	4.3	5.1	4.4	3.0	2.8	2.2	1.6	1.3
20			1.75	2.1	4.3	5.2	4.3	3.0	2.8	2.1	1.6	1.3
21				2.1	4.2	5.2	4.3	3.0	2.8	2.1	1.6	1.3
22				2.2	4.2	5.3	4.2	3.0	2.8	2.1	1.6	1.3
23				2.2	4.2	5.3	4.2	3.1	2.8	2.1	1.6	1.3
24				2.3	4.1	5.4	4.1	3.1	2.7	2.0	1.6	1.3
25				2.3	4.1	5.4	4.1	2.9	3.1	2.0	1.6	1.4
26				2.3	4.0	5.4	4.0	2.9	2.9	2.0	1.6	1.4
27				2.4	4.0	5.5	4.0	2.9	2.8	2.0	1.5	1.4
28				2.4	4.0	5.5	4.0	3.1	2.8	2.0	1.5	1.4
29				2.4	4.0	5.6	3.9	3.1	2.8	1.9	1.5	1.4
30			1.65	2.4	3.9	5.6	3.9	3.2	2.8	1.9	1.5	1.4
31				.....	3.9	.....	3.8	3.3	.....	1.9	.....	1.5
1908.[b]												
1				1.8	3.6	4.25	3.5	2.7	1.9	1.6	1.6	1.15
2	1.1			1.8	3.5	4.55	3.5	2.65	1.85	1.6	1.6	.....
3				.....	3.5	4.65	3.6	2.6	1.8	1.6	1.6	.....
4				.....	3.6	.....	3.65	2.6	1.7	1.55	1.6	.....
5				1.8	3.4	c9.4	3.8	2.55	1.7	1.5	1.6	.....
6		1.35		.....	3.2	9.2	3.85	2.5	1.7	1.5	1.6	.....
7				.....	3.3	9.1	3.8	2.45	1.7	1.5	1.55	.....
8				.....	3.5	8.1	3.7	2.4	1.7	1.49	1.55	1.15
9	1.0			1.9	3.75	7.5	3.7	2.35	1.7	1.49	1.5	.....
10				.....	3.9	6.8	3.75	2.3	1.7	1.5	1.5	.....
11				.....	4.1	6.45	3.75	2.3	1.7	1.5	1.5	.....
12		1.2	2.1	2.0	4.25	6.25	3.75	2.35	1.7	1.55	1.5	.....
13				2.0	4.2	5.9	3.7	2.3	1.7	1.55	1.5	.....
14				.....	4.25	5.6	3.8	2.3	1.7	1.6	1.5	.....
15				1.8	4.25	5.4	3.75	2.25	1.7	1.7	1.55	.....
16	1.2			.....	4.25	5.3	3.85	2.2	1.7	1.75	1.55	1.1
17				1.85	4.2	5.2	3.7	2.15	1.7	1.75	1.5	.....
18				.....	4.05	5.05	3.7	2.1	1.75	1.75	1.5	.....
19			1.8	.....	3.9	4.8	3.6	2.1	1.85	1.75	1.45	.....
20		1.8		2.2	3.85	4.65	3.45	2.1	1.8	1.8	1.4	.....
21				.....	3.75	4.45	3.4	2.05	1.8	1.8	1.4	.....
22				3.6	3.65	4.2	3.35	2.05	1.8	1.75	1.5	.....
23	1.15			.....	3.65	3.95	3.35	2.15	1.7	1.7	1.5	1.15
24				.....	3.6	3.85	3.35	2.1	1.75	1.7	1.5	.....
25				3.4	3.65	3.75	3.3	2.1	1.75	1.7	1.5	.....
26		1.1		3.4	3.7	3.95	3.2	2.1	1.75	1.7	1.5	.....
27				3.4	3.9	3.85	3.1	2.1	1.75	1.7	1.5	.....
28				3.6	3.9	3.8	3.0	2.1	1.7	1.7	1.5	.....
29				3.5	3.85	3.75	2.9	2.1	1.65	1.7	.....	.....
30	1.1			3.5	3.9	3.6	2.8	2.1	1.65	1.7	.....	1.15
31				.....	4.0	.....	2.75	2.0	.....	1.65	.....	.....

[a] Ice conditions prevailed January 1 to March 31, 1907.

[b] Ice conditions prevailed from January 1 to about March 31 and November 29 to December 31, 1908. During the former period readings were to under surface of ice and during the latter period they were to water surface in a hole cut in the ice.

[c] Gage height estimated.

Rating tables for St. Mary River near Babb, Mont.

JANUARY 1, 1907, TO JUNE 3, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	19	2.10	270	3.10	765	4.20	1,625
1.20	31	2.20	307	3.20	835	4.40	1,800
1.30	47	2.30	346	3.30	905	4.60	1,980
1.40	67	2.40	388	3.40	980	4.80	2,160
1.50	90	2.50	433	3.50	1,055	5.00	2,350
1.60	115	2.60	481	3.60	1,130	5.20	2,550
1.70	142	2.70	532	3.70	1,210	5.40	2,760
1.80	171	2.80	585	3.80	1,290	5.60	2,980
1.90	202	2.90	640	3.90	1,370	5.80	3,220
2.00	235	3.00	700	4.00	1,455	6.00	3,460

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907, one made during 1908, and the form of previous rating curves. It is well defined above gage height 1.7 feet.

JUNE 5 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	70	2.10	466	3.20	1,140	4.60	2,400
1.10	94	2.20	516	3.30	1,220	4.80	2,610
1.20	120	2.30	568	3.40	1,300	5.00	2,830
1.30	148	2.40	623	3.50	1,380	5.20	3,050
1.40	178	2.50	680	3.60	1,460	5.40	3,270
1.50	211	2.60	740	3.70	1,540	5.60	3,490
1.60	247	2.70	800	3.80	1,630	5.80	3,710
1.70	286	2.80	865	3.90	1,720	6.00	3,950
1.80	328	2.90	930	4.00	1,810	7.00	5,150
1.90	372	3.00	1,000	4.20	2,000	8.00	6,300
2.00	418	3.10	1,070	4.40	2,200	9.00	7,500

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and the form of previous rating curves. It is well defined between gage heights 1.5 and 2.5 feet, and is believed to be accurately located above gage height 2.5 feet.

Monthly discharge of St. Mary River near Babb, Mont., for 1907 and 1908.

[Drainage area, 177 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January [a]	.....	.....	80	0.452	0.52	4,920	D.
February [a]	.....	.....	110	.622	.65	6,110	D.
March [a]	.....	.....	80	.452	.52	4,920	D.
April	388	142	234	1.32	1.47	13,900	B.
May	1,710	388	1,010	5.71	6.58	62,100	A.
June	2,980	1,370	2,370	13.4	14.92	141,000	A.
July	2,980	1,290	2,090	11.8	13.61	129,000	A.
August	1,290	640	893	5.05	5.82	54,900	A.
September	905	532	694	3.94	4.40	41,300	A.
October	532	202	343	1.94	2.24	21,100	B.
November	202	90	136	.769	.86	8,090	C.
December	90	47	74.5	.421	.49	4,580	D.
The year	2,980	.....	676	3.82	52.08	492,000	

[a] Ice conditions and discharge estimated.

Monthly discharge of St. Mary River near Babb, Mont., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
1908.							
January [a]			20	0.113	0.13	1,230	D.
February [a]			50	.282	.30	2,880	D.
March [a]			170	.960	1.11	10,500	D.
April	1,130	171	474	2.68	2.99	28,200	A.
May	1,670	835	1,300	7.34	8.46	79,900	A.
June	7,980	1,460	3,400	19.2	21.42	202,000	B.
July	1,680	832	1,380	7.80	8.99	84,800	B.
August	800	418	554	3.13	3.61	34,100	A.
September	372	266	301	1.70	1.90	17,900	A.
October	328	208	264	1.49	1.72	16,200	A.
November	247		228	1.29	1.44	13,600	B.
December [a]			85	.480	.55	5,230	D.
The year	7,980		686	3.87	52.62	497,000	

[a] Ice conditions and discharge estimated.

ST. MARY RIVER NEAR CARDSTON, ALBERTA.

This station was established September 4, 1902, near Shaws ranch, one-fourth mile north of the boundary line between the United States and Canada and 17 miles south of Cardston, Alberta, for the purpose of obtaining data for use in connection with irrigation projects in the Milk River valley.

The station is 6 miles below the mouth of Kennedy Creek, the last tributary entering from the United States. With the exception of Boundary Creek, a small stream entering a short distance above the station, the drainage area lies within the United States. The total drainage area is 452 square miles.

The only diversion above the station is that which is being made at Babb by the United States Reclamation Service in connection with the Milk River project. About 850 second-feet of water will be diverted into the Milk River drainage basin.

During high water in June, 1908, the gage was destroyed and the channel changed. A new gage was put in July 17, 1908, about one-fourth mile below the old station. There is no relation between the two gages. Results at this station are good except during the winter months, when they are affected by ice.

Discharge measurements of St. Mary River near Cardston, Alberta, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	J. E. Stewart	140	370	5.35	1,840
June 7	J. B. Pierson	165	599	6.68	4,560
July 2	do	166	677	6.68	4,700
August 8	do	135	402	5.15	1,560
September 7	Follansbee and Pierson	135	364	4.88	1,240
1908.					
April 18	A. F. Huch	128	293	4.40	777
August 26	Stewart and Huch	92	397	2.58	691
October 7 [a]	A. F. Huch	133	182	1.83	425

[a] Wading measurement, 400 feet below cable.

Daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				3.2	4.05	.....	6.75	5.45	4.95	4.65	3.6	3.25
2				3.35	4.05	6.5	6.7	5.4	4.95	4.65	3.55	3.25
3				3.5	4.1	6.6	6.65	5.3	4.85	.....	3.55	3.25
4				3.45	4.1	6.5	6.6	5.3	4.85	4.45	3.55	3.2
5				3.45	4.1	6.4	6.6	5.25	4.85	4.4	3.5	.....
6				3.35	4.15	.....	6.4	5.2	4.85	4.4	3.5	3.15
7				3.3	4.45	6.7	6.3	5.2	4.85	4.35	3.45	3.15
8				3.35	4.55	6.75	6.2	5.15	4.8	4.35	3.4	3.1
9				3.45	4.6	6.7	6.1	.....	4.7	4.3	3.35	3.1
10				3.6	4.85	6.5	6.1	5.1	4.75	4.3	3.3	3.0
11				3.75	5.05	6.4	6.1	5.05	.....	4.25	3.3	2.9
12				3.85	5.25	6.35	6.0	5.05	.....	4.2	.....	2.9
13				.....	5.3	6.3	6.1	5.0	4.8	.....	3.25	2.9
14				3.95	5.35	6.25	.....	4.95	4.8	4.15	3.25	2.8
15				3.95	5.45	6.2	6.0	4.9	4.8	4.15	3.2	.....
16				4.0	5.8	6.15	5.95	4.9	4.85	4.0	3.15	.....
17				4.05	6.0	6.1	5.9	4.8	4.9	4.0	3.15	.....
18				4.05	6.2	6.1	5.9	4.75	4.95	3.95	3.1	.....
19				4.05	6.15	6.15	5.85	4.6	4.9	3.95	3.1	.....
20				4.05	6.1	6.2	5.8	4.55	4.9	3.9	3.1	.....
21				4.1	6.0	.....	5.8	4.55	4.85	3.9	3.05	.....
22				4.1	6.0	6.95	5.85	4.5	4.85	3.85	3.0	.....
23			4.0	4.15	5.85	7.05	5.8	4.4	4.85	3.85	3.0	.....
24				4.15	5.7	6.75	5.75	.....	4.85	3.85	3.0	.....
25				4.15	5.6	6.65	.....	4.6	4.85	3.8	3.0	.....
26				4.2	5.6	6.6	5.7	4.55	4.8	3.8	3.1	.....
27				.....	5.5	6.75	5.6	4.6	4.8	.....	3.1	.....
28				4.1	5.5	6.8	5.65	4.9	4.8	3.7	3.15	.....
29				4.1	5.5	6.9	5.5	4.9	4.8	3.7	3.15	.....
30			3.2	4.05	5.7	6.8	5.5	5.0	4.7	3.65	3.2	.....
31				.....	6.0	.....	5.45	4.95	.....	3.6	.....	.....

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1908.[b]				1908.[b]				1908.[b]			
1	.....	4.95	6.95	11	3.35	5.85	.....	21	5.10	5.60	.....
2	3.30	5.00	6.80	12	3.50	6.00	.....	22	5.15	5.55	.....
3	3.30	5.00	6.60	13	3.65	6.05	.....	23	5.25	5.50	.....
4	3.55	5.05	7.35	14	3.80	6.05	.....	24	5.30	5.50	.....
5	3.30	5.10	.....	15	3.90	6.10	.....	25	5.35	5.50	.....
6	3.30	.....	.....	16	3.95	6.10	.....	26	5.30	5.90	.....
7	3.30	5.40	.....	17	4.10	6.00	.....	27	5.25	6.30	.....
8	3.25	5.70	.....	18	4.40	.....	.....	28	5.20	6.10	.....
9	3.20	5.80	.....	19	.....	5.70	.....	29	5.10	5.80	.....
10	3.25	5.85	.....	20	4.90	5.70	.....	30	5.00	5.80	.....
								31	.....	6.20	.....

[a] Ice conditions prevailed from January 1 to about March 31, 1907. December 15 to 31, 1907, open channel in center of river but no water at gage.

[b] Ice conditions prevailed from January 1 to April 1 and from December 11 to 30, 1908. Gage and cable washed out by high water June 5 and replaced by new equipment July 27, 1908. The new gage was placed at a different section and to a new datum. The crest stage of the flood was estimated 12.75 feet.

Rating table for St. Mary River near Cardston, Alberta, for January 1, 1907, to June 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	174	4.00	560	5.00	1,390	6.00	3,040
3.10	198	4.10	620	5.10	1,510	6.20	3,490
3.20	225	4.20	685	5.20	1,640	6.40	3,960
3.30	255	4.30	755	5.30	1,780	6.60	4,450
3.40	288	4.40	830	5.40	1,930	6.80	4,960
3.50	325	4.50	910	5.50	2,090	7.00	5,490
3.60	365	4.60	995	5.60	2,260	7.20	6,040
3.70	410	4.70	1,085	5.70	2,440		
3.80	455	4.80	1,180	5.80	2,630		
3.90	505	4.90	1,280	5.90	2,830		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 33 discharge measurements made during 1902 to 1908, and is well defined.

Monthly discharge of St. Mary River near Cardston, Alberta, for 1907 and 1908.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre feet.	
1907.							
January[a]			150	0.332	0.38	9,220	D.
February[a]			200	.443	.46	11,100	D.
March[a]			150	.332	.38	9,220	D.
April	685	225	489	1.08	1.20	29,100	B.
May	3,490	590	1,930	4.27	4.92	119,000	A.
June	5,620	3,260	4,260	9.42	10.51	253,000	A.
July	4,830	2,010	3,120	6.90	7.96	192,000	A.
August	2,010	830	1,330	2.94	3.39	81,800	A.
September	1,330	1,080	1,210	2.68	2.99	72,000	A.
October	1,040	365	567	1.25	1.44	34,900	B.
November	365	174	244	.542	.60	14,500	B.
December[a]			157	.347	.40	9,650	D.
The year	5,620		1,150	2.54	34.63	835,000	
1908.							
January[b]			50	.111	.13	3,070	D.
February[b]			100	.221	.24	5,750	D.
March[b]			225	.498	.57	13,800	D.
April	1,860	225	844	1.87	2.09	50,200	A.
May	3,720	1,340	2,490	5.51	6.35	153,000	A.
June 1–4	6,440	4,450	5,300	11.7	1.74	42,000	A.
The period						268,000	

[a] Ice conditions and discharge estimated January to March and December 15–31, 1907.
[b] Ice conditions and discharge estimated.

NOTE.—Discharge June 5 to December 31, 1908 withheld pending the taking of further discharge measurements to properly define the rating curve for the new section.

SWIFTCURRENT CREEK NEAR BABB, MONT.

This station is located about 1 mile from the mouth of the stream, at a point where it leaves the foothills. It was established April 8, 1902, to obtain data for use in connection with irrigation projects on the Blackfoot Indian Reservation and in the Milk River valley. The drainage area above this station is 101 square miles.

There is no diversion or storage above this station. It is possible to construct storage reservoirs on this stream, and because of the great fall which the stream has, considerable power can be developed. Although the current is swift, the flow during the winter months is to some extent affected by ice.

The gage first established was washed away by high water in June, 1902, and the station was reestablished July 30, 1902, at a point 1,800 feet above the first gage. It was again moved September 27, 1902, to a point about 900 feet farther up stream, and set at a different datum. It remained at this location until it was destroyed by the high water June 5, 1908. July 26, 1908, the gage was reestablished at a new datum, about 100 feet above its former location.

Discharge measurements of Swiftcurrent Creek near Babb, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 21[a]	W. S. Hanna	.....	51	2.18	120
May 14	J. E. Stewart	57	137	3.70	612
June 6	J. B. Pierson	62	181	4.85	1,460
July 3	do	62	202	4.85	1,500
August 9	do	55	88	3.45	375
September 6	Follansbee and Pierson	54	94	3.38	350
October 26[b]	L. R. Stockman	46	77	2.60	104
1908.					
April 18	A. F. Huch	54	89.2	3.52	357
July 26[b]	Stewart and Huch	70	107	3.45	408
August 22[b]	do	62	94.7	3.12	250
August 28[b]	do	65	80	2.80	134
October 8[b]	A. F. Huch	60	74	2.67	95.8

[a] Ice along both shores. [b] Wading measurements.

Daily gage height, in feet, of Swiftcurrent Creek near Babb, Mont., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	.....	.....	.....	2.1	2.5	4.1	4.7	.....	3.6	3.2	2.5	2.3
2	.....	.....	.....	2.1	2.6	4.2	4.7	.....	3.6	3.1	2.5	2.3
3	.....	.....	.....	2.1	2.5	4.3	4.7	.....	3.6	3.1	2.5	2.3
4	.....	.....	.....	2.2	2.5	4.4	4.6	.....	3.5	3.1	2.5	2.3
5	.....	.....	.....	2.1	2.6	4.6	4.6	.....	3.5	3.0	2.5	2.2
6	.....	.....	.....	2.1	2.9	4.8	4.6	.....	3.4	3.0	2.5	2.2
7	.....	.....	.....	2.2	2.8	4.9	4.6	.....	3.4	3.0	2.5	2.2
8	.....	.....	.....	2.5	3.0	5.0	4.6	.....	3.4	3.0	2.5	2.2
9	.....	.....	.....	2.4	3.3	4.9	4.5	3.5	3.3	3.0	2.4	2.2
10	.....	.....	.....	2.5	3.7	4.9	4.5	.....	3.3	3.0	2.4	2.2
11	.....	.....	.....	2.6	3.8	4.8	4.5	3.6	3.3	2.9	2.4	2.2
12	.....	.....	.....	2.8	3.9	4.8	4.4	3.5	3.4	2.9	2.4	2.3
13	.....	.....	.....	2.8	4.1	4.8	4.4	3.5	3.4	2.8	2.3	2.3
14	.....	.....	.....	2.8	4.3	4.7	4.4	3.4	3.4	2.8	2.3	2.3
15	.....	.....	.....	2.8	4.3	4.7	4.4	3.4	3.4	2.8	2.3	2.3
16	.....	.....	.....	2.8	4.6	4.8	4.3	3.4	3.4	2.8	2.3	2.3
17	.....	.....	.....	2.7	4.8	4.8	4.3	3.3	3.4	2.8	2.3	2.3
18	.....	.....	.....	2.7	4.9	4.8	4.2	3.3	3.4	2.8	2.3	2.3
19	.....	.....	.....	2.6	4.7	5.0	4.2	3.3	3.5	2.7	2.3	2.1
20	.....	.....	.....	2.7	4.6	5.0	4.1	3.2	3.5	2.7	2.3	2.1
21	.....	.....	.....	2.6	4.4	5.1	4.0	3.2	3.5	2.7	2.3	2.1
22	.....	.....	.....	2.6	4.0	5.2	3.9	3.2	3.4	2.6	2.3	2.1
23	.....	.....	.....	2.5	3.8	5.2	3.9	3.2	3.5	2.6	2.3	2.1
24	.....	.....	.....	2.6	3.7	5.2	3.8	3.1	3.5	2.6	2.3	2.1
25	.....	.....	.....	2.5	3.6	5.2	3.8	3.1	3.5	2.6	2.3	2.2
26	.....	.....	.....	2.5	3.7	5.2	3.7	3.3	3.5	2.6	2.3	2.2
27	.....	.....	.....	2.5	3.8	5.2	3.7	3.4	3.4	2.6	2.3	2.2
28	.....	.....	.....	2.6	3.9	5.2	3.6	3.7	3.4	2.6	2.3	2.2
29	.....	.....	.....	2.5	3.9	5.2	3.6	3.7	3.4	2.6	2.3	2.2
30	.....	.....	.....	2.5	4.2	5.2	3.5	3.7	3.4	2.5	2.3	2.2
31	.....	.....	.....	.....	4.5	.....	3.5	3.8	.....	2.5	.....	2.2
1908.[b]												
1	.....	.....	.....	2.2	3.8	4.95	.....	3.1	2.8	2.75	2.9	.....
2	1.8	.....	.....	2.2	3.7	.....	.....	3.1	2.75	2.75	2.9	2.3
3	.....	.....	.....	2.2	3.7	5.0	.....	3.0	2.7	2.75	2.9	.....
4	.....	.....	.....	2.2	3.8	.....	.....	3.0	2.7	2.75	2.8	.....
5	.....	.....	2.3	2.2	4.15	.....	.....	3.0	2.7	2.7	2.8	.....
6	.....	1.75	.....	2.2	4.3	.....	.....	2.95	2.7	2.7	2.75	.....
7	.....	.....	.....	2.2	4.3	.....	.....	2.95	2.75	2.7	2.75	.....
8	.....	.....	.....	2.2	4.4	.....	.....	2.9	2.75	2.67	2.75	2.25
9	1.8	.....	.....	2.4	4.3	.....	.....	2.85	2.8	2.67	2.7	.....
10	.....	.....	.....	2.4	4.2	.....	.....	2.8	2.8	2.7	2.7	.....

[a] Ice conditions prevailed from January 1 to about March 31, 1907.
[b] Ice conditions prevailed from January 1 to about March 31 and from November 29 to December 31, 1908. On June 4 the high water washed out both gage and cable. They were replaced July 26, 1908, the gage being located at a slightly different section.

Daily gage height, in feet, of Swiftcurrent Creek near Babb, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
11				2.4	4.25			2.8	2.8	2.7	2.6	
12		1.8	2.6					2.9	2.8	2.7	2.55	
13				2.8	4.25			2.9	2.8	2.7	2.5	
14					4.35			2.95	2.75	2.8	2.5	
15				3.1				2.9	2.7	2.9	2.5	
16	1.8				4.2			2.85	2.7	2.95	2.6	2.2
17								2.85	2.75	3.0	2.55	
18				3.5	3.9			2.8	2.8	3.1	2.55	
19			2.4					2.9	2.85	3.1	2.55	
20		2.3		4.2	3.9			3.0	2.8	3.4	2.6	
21								3.05	2.8	3.7	2.6	
22				3.8	3.9			3.05	2.8	3.5	2.55	
23	1.75							3.0	2.8	3.35	2.55	2.1
24					4.1			3.0	2.8	3.2	2.5	
25				3.95				2.9	2.75	3.2	2.5	
26				3.8	4.25		3.45	2.9	2.7	3.3	2.5	
27				3.6			3.35	2.8	2.7	3.2	2.5	
28				3.8	4.1		3.3	2.8	2.7	3.2	2.5	
29				3.8			3.2	2.75	2.6	3.1		
30				3.9	4.2		3.2	2.8	2.6	3.1		2.15
31	1.75						3.15	2.8		3.1		

Rating tables for Swiftcurrent Creek near Babb, Mont.

JANUARY 1 TO MAY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	90	3.10	340	4.10	850
2.20	106	3.20	377	4.20	920
2.30	124	3.30	417	4.30	995
2.40	144	3.40	460	4.40	1,070
2.50	166	3.50	506	4.50	1,150
2.60	190	3.60	554	4.60	1,230
2.70	216	3.70	605	4.70	1,320
2.80	244	3.80	660	4.80	1,420
2.90	274	3.90	720	4.90	1,520
3.00	306	4.00	785	5.00	1,620

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1906 and two made during 1907. It is not well defined.

JUNE 1, 1937, TO JUNE 3, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	29	3.20	280	4.20	880
2.20	39	3.30	321	4.30	965
2.30	51	3.40	366	4.40	1,050
2.40	65	3.50	415	4.50	1,140
2.50	82	3.60	470	4.60	1,230
2.60	102	3.70	530	4.70	1,320
2.70	124	3.80	590	4.80	1,420
2.80	149	3.90	655	4.90	1,520
2.90	177	4.00	725	5.00	1,620
3.00	208	4.10	800	5.20	1,840
3.10	242				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908 and is fairly well defined above gage height 2.5 feet.

Rating tables for Swiftcurrent Creek near Babb, Mont.—Continued.

JULY 26 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	21	2.80	133	3.30	329
2.30	32	2.90	165	3.40	380
2.40	45	3.00	200	3.50	434
2.50	61	3.10	239	3.60	491
2.60	80	3.20	282	3.70	551
2.70	104				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 after the establishment of the new gage and is well defined between gage heights 2.5 and 3.5 feet.

Monthly discharge of Swiftcurrent Creek near Babb, Mont., for 1907 and 1908.

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre feet.	
1907.							
January[a]			50	0.495	0.57	3,070	D.
February[a]			65	.644	.67	3,610	D.
March[a]			50	.495	.57	3,070	D.
April	244	90	171	1.69	1.89	10,200	C.
May	1,520	166	713	7.06	8.14	43,800	B.
June	1,840	800	1,510	15.0	16.69	89,800	A.
July	1,320	415	912	9.03	10.41	56,100	A.
August	590	242	387	3.83	4.42	23,800	A.
September	470	321	387	3.83	4.27	23,000	A.
October	280	82	157	1.55	1.79	9,650	B.
November	82	51	61.1	.605	.68	3,640	C.
December	51	29	41.3	.409	.47	2,540	D.
The year	1,840		375	3.72	50.57	272,000	
1908.							
January[a]			15	.149	.17	922	D.
February[a]			25	.248	.27	1,440	D.
March[a]			50	.495	.57	3,070	D.
April	880	39	333	3.30	3.68	19,800	C.
May	1,220	530	821	8.13	9.37	50,500	B.
June[b]		1,570	1,940	19.2	21.42	115,000	C.
July[c]	730	260	547	5.42	6.25	33,600	C.
August	239	118	171	1.69	1.95	10,500	A.
September	149	80	118	1.17	1.30	7,020	A.
October	551	97	208	2.06	2.38	12,800	A.
November	165	35	91.9	.910	1.02	5,470	A.
December[a]			18	.178	.21	1,110	D.
The year			362	3.58	48.59	261,000	

[a] Ice conditions and discharge estimated.
[b] Discharge obtained by using the same rate of run-off per square mile as St. Mary River near Babb.
[c] July 1–25, 1908, obtained from comparative hydrographs of the three stations in this vicinity.

RED RIVER DRAINAGE BASIN.

DESCRIPTION.

Red River rises in Minnesota, its most remote source being a small lake near the southwest corner of Clearwater County, about 13 miles west of Lake Itasca, at an elevation of about 1,550 feet above sea level. From this point it flows south 60 miles (measured in a direct line) through a succession of small lakes to Ottertail Lake (elevation

about 1,315 feet), and thence it flows westward 42 miles to Breckenridge, Minn., and Wahpeton, N. Dak. (elevation 943 feet). From this point it runs northward 285 miles, measured in a direct line, to the southern end of Lake Winnipeg, passing the Canadian boundary at Pembina at a distance of 190 miles and the city of Winnipeg at about 250 miles. On account of the meanderings of the river, the length of its channel is nearly double the length of the direct line.

Lake Winnipeg is about 250 miles long, and from its northern end Nelson River flows northeastward 400 miles to Hudson Bay.

The upper portion of Red River is called Ottertail River, that name being variously applied down as far as Ottertail Lake, Fergus Falls, or Breckenridge and Wahpeton as a lower limit; the portion flowing northward from Wahpeton to Lake Winnipeg is universally called Red River.

From Wahpeton to Lake Winnipeg the fall of the main portion of the river is small, the low-water elevation at Pembina being 750 feet, and the elevation of Lake Winnipeg 710 feet. From Wahpeton to Pembina the river forms the boundary between the States of Minnesota and North Dakota, and in this stretch it occupies the middle of the broad, smooth plain well known as the Red River valley. This plain is 40 to 50 miles wide and has no slope perceptible to the eye, the rise away from the river being only 3 to 6 feet to the mile. Red River valley was occupied during the glacial epoch by a lake, known to geologists as Lake Agassiz; at that time, the outlet to the north being filled by the ice sheet, the valley filled until the overflow passed away through Lake Traverse and Bigstone Lake into the head of Minnesota River, 65 miles south of Breckenridge. The whole district is now deeply covered with glacial drift, or, in the lake bottom, with an even layer of silt. No rock in place is found.

The principal tributaries of Red River are as follows: On the east side, Pelican, Buffalo, Wild Rice, Red Lake, and Snake rivers, and Two Rivers; on the west side, Bois des Sioux, Wild Rice, Sheyenne, Goose, Park, and Pembina rivers. The Bois des Sioux forms the Minnesota-North Dakota boundary from Wahpeton to the southeast corner of North Dakota, but is otherwise of no importance, being merely a prairie stream having very small flow except during a few weeks in the spring. These tributaries drain a district bounded on the south by the Minnesota River drainage area; on the east by the areas of the upper Mississippi River and of Rainy River (which flows into Lake Winnipeg); on the west by the area of James River (which flows into the Missouri), by the Devils Lake area (an inland basin), and by the area of Mouse River, which enters Red River at Winnipeg.

At the margins of this drainage area elevations range between 1,200 and 1,600 feet, but the boundaries are not precisely defined. Along much of the eastern side the country is so level that the

numerous swamps and marshes drain with equal facility to either side; along the western side there are wide belts whose drainage systems were destroyed by the accumulation of drift and moraines left by the ice at the glacial epoch; and in these belts the surface water collects in innumerable hollows, kettle holes, and sloughs, and stands till it evaporates. If the rainfall were greater these many sinkholes and lakelets would overflow, and natural erosion would perfect the drainage system and make it again apparent to the eye. Large areas of swamp or undrained land are being gradully reclaimed by extensive artificial drainage systems, which have the effect of bringing the water more quickly to the stream after storms or the spring thaw; and it is possible that the regimen of some of the streams is being greatly altered by the construction of ditches.

So far as can be determined from the best existing maps the drainage area tributary to Red River above the point where it crosses the Canadian boundary at Pembina comprises about 34,500 square miles, of which 16,400 are in Minnesota, 500 in South Dakota, 15,600 in North Dakota, and 2,000 in Manitoba (in the Pembina River drainage area).

East of a north-and-south line drawn about 50 miles east of the main Red River, the whole country may be said to be heavily timbered; west of such a line it is open prairie, treeless except along the streams.

The mean annual rainfall of the Red River drainage area increases uniformly from east to west, being 15 to 18 inches at the western boundary; 19 to 24 inches at stations in the middle of the valley; and 24 to 26 inches at the eastern boundary. On account of the larger rainfall on the eastern side of the area the run-off per square mile from the tributaries on this side is from two to ten times as great as that from the tributaries on the west side. About 75 per cent of the total rainfall occurs in the six months from April 1 to September 30.

The basin lies so far north that the streams are icebound from the middle of November until late in March or early in April, and the winter flow is small but uniform, for thaws sufficient to cause winter floods never occur. Destructive floods sometimes occur in the spring, however, if the snow accumulation is large and if the ground is frozen so deeply that little of the water percolates downward.

The headwaters of the tributaries on the eastern side, nearly every one of which passes through numerous lakes, afford many opportunities for inexpensive storage; on the west side a few localities for limited storage are also found on Pembina and Sheyenne rivers; on Red River itself below Breckenridge there is no opportunity for storage.

The lake-regulated tributaries on the eastern side also present opportunities for power development, and a number of power plants are now in operation; but the flow of the prairie tributaries from the

west is so irregular that no important power development is possible without extensive storage to carry over the low-water periods of late summer, fall, and winter. On the Red below and above Fergus Falls, on the Pelican, the Wild Rice, the Red Lake, and the Clearwater, and on the smaller streams there are many other opportunities for profitable power development under heads of 10 to 25 feet.

Red Lake River and its tributaries are extensively used for logging, and some logging is also done on Wild Rice River.

Red River is navigable from Grand Forks down to Winnipeg. Theoretically it is navigable from Grand Forks up to Breckenridge except during low water, but in recent years there has been no traffic except in the lower 25 miles of this portion, and many fixed bridges have been cheaply built, practically closing it to navigation. Red Lake River is navigable in its lower course and also in the upper 40 miles, there being regular traffic from Thief River Falls to Red Lake.

The records of the gaging stations in this area provide data of value for general statistical and comparative use in questions involving the seasonal or total flow of the whole river or any of its tributaries. The chief questions that will arise on the main river involve the prevention of flood damage and navigation; on the tributaries, water power, flood damage, and opportunities for drainage development.

The following gaging stations have been maintained in this river basin:

Ottertail River near Fergus Falls, Minn., 1904–1908.
Red River at Fargo, N. Dak., 1901–1908.
Red River at Grand Forks, N. Dak., 1901–1908. (Gage height record 1895–1901.)
Red River at Emerson, Manitoba, 1902.
Sheyenne River at Haggart, N. Dak., 1902–1907.
Devils Lake near Devils Lake, N. Dak., 1901–1908.
Red Lake River at Crookston, Minn., 1901–1908.
Pembina River at Neche, N. Dak., 1903–1908.
Mouse River near Foxholm, N. Dak., 1904–1906.
Mouse River at Minot, N. Dak., 1903–1908.
Des Lacs River at Foxholm, N. Dak., 1904–1906.

OTTERTAIL RIVER NEAR FERGUS FALLS, MINN.

This station, which was established May 9, 1904, is located at Three-mile Bridge, about 3½ miles northeast of Fergus Falls, Minn., but because of the loop in the river it is 8 miles higher up the valley than Fergus Falls.

The records furnish information of especial value in connection with the future development of water power, for which this stream is particularly available.

Ottertail Lake, which has an area of about 22 square miles, is 20 miles above the station, and this, with other smaller lakes farther above, steadies the flow. The recorded range of gage heights at the station is only 1.45 feet.

The gravel channel at the station is remarkably permanent. There have been no changes in the gage datum or discharge curve since the establishment of the station, and the results are excellent for the entire open season. No records have been kept for the winter season, which lasts from about December 1 to April 1.

Discharge measurements of Ottertail River near Fergus Falls, Minn., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 19	E. F. Chandler	93	197	3.51	603
August 1	Follansbee and Chandler	92	164	3.26	427
1908.					
June 26	E. F. Chandler	92.5	243	4.05	894
October 26	do	90	136	2.97	293

Daily gage height, in feet, of Ottertail River near Fergus Falls, Minn., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				3.9	3.8	3.7	3.7	3.25	2.95	3.05	3.05	3.1
2				3.8	3.8	3.7	3.7	3.25	2.95	3.05	3.05	3.1
3				3.8	3.8	3.7	3.7	3.2	2.9	3.05	3.05	3.15
4				3.8	3.8	3.65	3.65	3.2	2.9	3.05	3.0	3.15
5				3.7	3.8	3.65	3.65	3.2	2.9	3.05	3.0	3.15
6				3.65	3.8	3.65	3.65	3.2	2.9	3.05	3.0	3.15
7				3.65	3.8	3.65	3.65	3.2	2.9	3.05	3.0	3.15
8				3.65	3.8	3.65	3.6	3.2	2.9	3.1	3.0	.....
9				3.6	3.8	3.65	3.6	3.15	2.9	3.1	3.0	.....
10				3.6	3.8	3.65	3.6	3.15	2.9	3.1	3.0	.....
11				3.55	3.8	3.7	3.55	3.15	2.9	3.1	3.0	.....
12				3.55	3.8	3.7	3.55	3.15	2.9	3.1	3.05	.....
13				3.55	3.8	3.75	3.55	3.15	3.05	3.1	3.05	.....
14				3.55	3.75	3.8	3.55	3.1	3.05	3.1	3.05	.....
15				3.55	3.75	3.8	3.55	3.1	3.05	3.1	3.1	.....
16				3.6	3.75	3.8	3.5	3.1	3.05	3.05	3.1	.....
17				3.6	3.75	3.85	3.5	3.1	3.0	3.05	3.1	.....
18				3.6	3.75	3.85	3.5	3.1	3.0	3.05	3.1	.....
19				3.65	3.75	3.85	3.55	3.1	3.0	3.05	3.1	.....
20				3.65	3.75	3.8	3.55	3.05	3.0	3.05	3.05	.....
21				3.65	3.8	3.8	3.5	3.05	3.0	3.05	3.05	.....
22				3.65	3.8	3.8	3.5	3.0	3.0	3.05	3.05	.....
23				3.7	3.8	3.8	3.5	3.0	3.0	3.0	3.05	.....
24				3.7	3.75	3.8	3.45	3.0	3.0	3.0	3.05	.....
25				3.75	3.75	3.8	3.4	3.0	3.0	3.0	3.05	.....
26				3.75	3.75	3.75	3.35	3.0	3.0	3.0	3.05	.....
27				3.75	3.75	3.75	3.35	3.0	3.0	3.0	3.05	.....
28				3.75	3.75	3.75	3.3	3.0	3.0	3.0	3.1	.....
29				3.75	3.75	3.75	3.3	3.0	3.0	3.05	3.1	.....
30				3.8	3.7	3.75	3.3	3.0	3.0	3.05	3.1	.....
31			3.9	.....	3.7	.....	3.3	3.0	.....	3.05	.....	.....
1908.[b]												
1				.....	3.1	3.55	4.0	3.5	3.15	3.05	2.9	.....
2				.....	3.1	3.55	4.0	3.5	3.15	3.05	2.9	.....
3				.....	3.1	3.6	3.95	3.5	3.15	3.05	2.9	.....
4				.....	3.1	3.65	3.95	3.45	3.15	3.05	2.9	.....
5				3.1	3.1	3.7	3.9	3.45	3.15	3.0	2.9	.....
6				3.1	3.1	3.7	3.9	3.45	3.15	3.0	2.9	.....
7				3.1	3.1	3.75	3.85	3.4	3.1	3.0	2.9	.....
8				3.0	3.1	3.8	3.85	3.4	3.1	3.0	2.9	.....
9				3.0	3.1	3.85	3.85	3.4	3.1	3.0	2.9	.....
10				2.95	3.1	3.95	3.8	3.4	3.1	3.0	2.9	.....
11				2.95	3.1	3.95	3.8	3.35	3.1	3.0	2.9	.....
12				2.95	3.15	4.1	3.8	3.35	3.1	3.0	2.9	.....
13				2.95	3.15	4.1	3.75	3.35	3.1	2.95	2.9	.....
14				2.95	3.2	4.1	3.75	3.3	3.1	2.95	2.9	.....
15				2.95	3.2	4.1	3.75	3.3	3.1	2.95	2.9	.....

[a] River frozen January to March and December 8–31, 1907.
[b] Ice conditions January 1 to April 5 and December 1–31, 1908.

Daily gage height, in feet, of Ottertail River near Fergus Falls, Minn., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16				2.9	3.25	4.05	3.7	3.3	3.1	2.95	2.85	
17				2.9	3.25	4.05	3.7	3.3	3.1	2.95	2.85	
18				2.9	3.25	4.05	3.7	3.25	3.1	2.95	2.85	
19				2.9	3.25	4.0	3.65	3.25	3.1	2.95	2.85	
20				2.9	3.3	4.0	3.65	3.25	3.1	2.95	2.85	
21				2.9	3.3	4.0	3.65	3.2	3.1	2.9	2.85	
22				2.9	3.3	4.0	3.6	3.2	3.1	2.9	2.85	
23				2.95	3.3	4.05	3.6	3.2	3.1	2.9	2.85	
24				2.95	3.35	4.05	3.6	3.2	3.1	2.95	2.85	
25				3.0	3.35	4.05	3.6	3.2	3.1	2.95	2.85	
26				3.05	3.4	4.05	3.6	3.2	3.1	2.95	2.8	
27				3.05	3.4	4.05	3.55	3.2	3.1	2.95	2.8	
28				3.05	3.4	4.05	3.55	3.15	3.1	2.95	2.8	
29				3.1	3.4	4.05	3.55	3.15	3.1	2.9	2.8	
30				3.1	3.5	4.0	3.5	3.15	3.1	2.9	2.8	
31					3.5		3.5	3.15		2.9		

Rating table for Ottertail River near Fergus Falls, Minn., for 1905 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	236	3.20	402	3.60	607	4.00	855
2.90	274	3.30	449	3.70	665	4.10	921
3.00	315	3.40	499	3.80	726		
3.10	357	3.50	552	3.90	789		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 14 discharge measurements made during 1904 to 1908, and is well defined.

Monthly discharge of Ottertail River near Fergus Falls, Minn., for 1907 and 1908.

[Drainage area 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	789	580	652	0.498	0.56	38,800	A.
May	726	665	709	.541	.62	43,600	A.
June	758	636	692	.528	.59	41,200	A.
July	665	449	565	.431	.50	34,700	A.
August	426	315	359	.274	.32	22,100	A.
September	336	274	303	.231	.26	18,000	A.
October	357	315	337	.257	.30	20,700	A.
November	357	315	336	.256	.29	20,000	A.
December	380		301	.230	.27	18,500	C.
The period						258,000	
1908.							
January			260	.198	.23	16,000	C.
February			230	.176	.19	13,200	C.
March			200	.153	.18	12,300	C.
April	357		312	.238	.27	18,600	A.
May	552	357	421	.321	.37	25,900	A.
June	921	580	813	.621	.69	48,400	A.
July	855	552	686	.524	.60	42,200	A.
August	552	380	454	.347	.40	27,900	A.
September	380	357	362	.276	.31	21,500	A.
October	336	274	301	.230	.27	18,500	A
November	274	236	261	.199	.22	15,500	A.
December			220	.168	.19	13,500	C.
The year			377	.288	3.92	274,000	

NOTE.—Ice conditions December 8-31, 1907; January 1 to April 5, and December 1-31, 1908. Discharge has been estimated for these periods.

RED RIVER AT FARGO, N. DAK.

This station, which is located at the highway bridge connecting Front street, Fargo, N. Dak., with Moorhead, Minn., was established May 23, 1901. Discharge measurements are made a half-mile farther upstream, at the footbridge at the Fargo waterworks pumping station, except at very high stage, when the Front Street Bridge or the Northern Pacific Railway bridge is used.

The drainage area above this station is about 6,020 square miles, 3,770 being in Minnesota, 500 in South Dakota, and 1,750 in North Dakota. The nearest tributary is Sheyenne River, which enters Red River, 10 miles below.

The gage datum has not been changed since the establishment of the station. The channel is in clay and silt, and slight changes in depth occur from time to time, but no large ones. The fall is so small that any accidental obstruction in the channel is likely to cause an appreciable effect for a long distance upstream, and to affect the rating. Hence, unless frequent discharge measurements are made slight errors will enter, but there have been no very great changes in the rating curves for eight years, and the records are fairly good except when affected by ice conditions.

The stream is smoothly closed by ice for about four months of the year. At the spring break-up, on account of the comparatively sluggish current and the fact that the river flows northward into a colder district, a pronounced backwater effect is usually caused by ice jams and partial ice jams, and the river is raised disproportionately high for several days or several weeks. At that season therefore the records can only be approximate unless daily discharge measurements are made.

Discharge measurements of Red River at Fargo, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 5	E. F. Chandler	430	3,100	24.99	5,720
April 8	do	220	1,680	20.34	3,360
April 15	do	89	668	13.80	2,390
Do	do	122	1,020	13.79	2,140
June 17	do	210	1,490	19.26	4,500
Do	do	172	1,940	19.28	4,360
September 13	do	98	280	7.79	389
1908.					
June 27	E. F. Chandler	125	837	12.81	1,930
August 29	do	104	347	8.57	516
November 7	do	103	300	8.10	450

NOTE.—Measurements made at various sections.

Daily gage height, in feet, of Red River at Fargo, N. Dak., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907. [a]												
1	11.0	.....	10.5	29.3	12.1	11.3	11.3	9.1	8.0	8.1	7.9	7.9
2	.....	.....	.....	28.6	12.0	11.2	11.2	9.0	7.9	8.1	8.0	7.8
3	.....	.....	.....	27.7	12.0	11.1	11.2	9.0	7.9	8.1	8.0	7.6
4	.....	.....	.....	26.6	11.9	11.0	11.1	8.9	7.9	8.2	8.1	7.5
5	.....	.....	.....	25.4	11.8	10.9	11.0	8.9	7.9	8.4	8.1	7.4
6	.....	.....	.....	23.6	11.7	10.9	10.9	8.8	7.9	8.4	8.2	7.5
7	.....	.....	.....	21.4	11.7	10.8	10.8	8.8	7.8	8.4	8.1	7.5
8	.....	.....	.....	20.3	11.7	10.7	10.7	8.9	7.8	8.4	8.1	7.6
9	.....	.....	.....	18.6	11.6	10.7	10.6	9.0	7.8	8.4	8.1	7.7
10	.....	.....	.....	17.6	11.5	10.8	10.6	9.0	7.8	8.3	8.1	7.9
11	.....	.....	.....	16.1	11.4	11.5	10.6	8.9	7.8	8.3	8.2	.....
12	.....	.....	.....	15.3	11.3	13.4	10.5	8.9	7.8	8.4	7.4	.....
13	.....	.....	.....	14.8	11.3	16.0	10.4	8.8	7.7	8.2	7.0	.....
14	.....	.....	.....	14.4	11.2	17.4	10.3	8.8	7.7	8.2	7.0	.....
15	.....	.....	.....	13.9	11.3	18.6	10.2	8.9	7.8	8.1	7.1	.....
16	.....	.....	.....	13.5	11.2	19.2	10.1	8.9	7.9	8.1	7.3	.....
17	.....	.....	.....	13.4	11.1	19.3	10.0	8.8	8.0	8.0	7.5	.....
18	.....	.....	10.3	13.0	11.1	18.9	9.9	8.7	8.0	8.0	7.7	.....
19	.....	.....	.....	12.7	11.0	18.0	9.8	8.6	8.1	8.1	7.9	.....
20	.....	.....	10.5	12.8	11.0	16.8	9.7	8.5	8.1	8.1	8.1	.....
21	.....	.....	10.8	12.8	10.9	15.5	9.8	8.4	8.2	8.1	8.2	.....
22	.....	.....	12.4	12.8	10.9	14.3	9.8	8.3	8.3	8.0	8.1	.....
23	.....	.....	16.6	12.7	10.9	13.5	9.7	8.3	8.4	8.0	8.0	.....
24	10.5	.....	20.5	12.6	10.9	12.7	9.7	8.2	8.4	8.0	7.9	.....
25	.....	.....	23.0	12.5	10.8	12.4	9.6	8.2	8.3	8.0	8.0	.....
26	.....	.....	25.1	12.4	10.8	12.2	9.6	8.1	8.3	8.0	8.1	.....
27	.....	.....	26.7	12.3	10.9	11.9	9.5	8.1	8.3	8.0	8.0	.....
28	.....	.....	28.3	12.2	11.0	11.7	9.4	8.0	8.3	8.0	8.1	.....
29	.....	.....	29.3	12.2	11.1	11.5	9.3	8.0	8.2	8.0	8.1	.....
30	.....	.....	29.8	12.1	11.1	11.4	9.2	8.0	8.1	8.0	7.9	.....
31	.....	.....	.....	.....	11.2	.....	9.1	8.0	.....	7.9	.....	.....
1908. [b]												
1	.....	.....	8.7	12.9	9.2	9.8	12.7	10.0	8.5	8.2	7.9	8.0
2	.....	.....	.....	12.7	9.1	9.9	12.5	9.9	8.5	8.3	7.9	.....
3	.....	.....	.....	12.4	9.0	10.0	12.3	9.9	8.5	8.3	7.9	.....
4	.....	.....	.....	12.8	8.9	9.9	12.1	9.8	8.5	8.2	7.8	.....
5	.....	.....	.....	13.9	8.9	9.8	12.0	9.7	8.5	8.1	7.9	.....
6	.....	.....	.....	13.6	8.8	9.9	11.9	9.5	8.5	8.0	8.0	.....
7	.....	.....	.....	12.9	8.8	10.0	11.8	9.5	8.4	8.0	8.0	.....
8	.....	.....	.....	12.9	8.8	10.1	11.7	9.4	8.3	7.9	7.9	.....
9	.....	.....	.....	12.8	8.7	10.3	11.5	9.4	8.2	7.9	7.8	.....
10	.....	.....	.....	12.9	8.7	12.0	11.3	9.3	8.1	7.9	7.8	.....
11	.....	.....	.....	12.3	8.7	13.5	11.3	9.3	8.0	7.9	7.8	.....
12	.....	.....	9.0	11.2	8.6	14.4	11.2	9.3	8.0	7.9	7.7	.....
13	.....	.....	9.5	10.3	8.6	14.7	11.0	9.3	8.0	7.9	6.2	.....
14	.....	.....	9.5	9.5	8.6	14.4	10.8	9.3	8.0	8.0	6.8	.....
15	.....	.....	10.1	9.2	8.6	14.3	10.6	9.2	8.0	7.9	6.8	.....
16	.....	.....	10.5	9.0	8.6	14.0	10.4	9.1	8.0	7.8	7.2	.....
17	.....	.....	11.0	8.9	8.6	14.0	10.5	9.1	8.0	7.8	7.6	.....
18	.....	.....	11.3	8.8	8.8	13.9	10.6	9.0	7.9	7.9	7.6	.....
19	.....	.....	11.5	8.7	8.9	13.7	10.6	9.0	7.9	7.9	7.6	.....
20	.....	.....	11.8	8.7	9.0	13.3	10.5	9.0	8.0	7.9	7.9	.....
21	.....	.....	10.7	8.7	9.2	12.9	10.4	8.9	8.1	7.9	7.9	.....
22	.....	.....	10.5	8.7	10.2	12.5	10.3	8.8	8.2	7.9	7.9	.....
23	.....	.....	11.1	8.6	9.6	12.4	10.3	8.7	8.1	7.9	7.9	.....
24	.....	.....	11.1	8.6	9.3	12.3	10.1	8.6	8.1	7.8	8.2	.....
25	.....	.....	11.2	8.7	9.3	12.3	10.0	8.5	8.1	7.8	8.6	.....
26	.....	.....	11.5	8.8	9.5	12.6	10.0	8.4	8.1	7.8	8.4	.....
27	.....	.....	11.9	8.9	9.6	12.8	10.5	8.4	8.1	7.8	8.2	.....
28	.....	.....	12.2	8.9	9.6	12.9	10.4	8.4	8.1	7.9	7.9	.....
29	.....	.....	12.5	9.0	9.9	12.9	10.4	8.5	8.1	8.0	7.6	.....
30	.....	.....	12.6	9.2	9.8	12.9	10.3	8.5	8.1	8.0	8.0	.....
31	.....	.....	12.8	.....	9.8	.....	10.1	8.5	.....	8.0	.....	.....

[a] Ice conditions January to April, and December 10–31, 1907. There was considerable backwater during April due to ice gorges.

[b] Ice conditions January 1 to April 6, and November 13 to December 31, 1908.

Rating table for Red River at Fargo, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
7.00	220	8.40	515	9.80	885	12.40	1,749
7.10	239	8.50	539	9.90	915	12.60	1,819
7.20	258	8.60	563	10.00	945	12.80	1,889
7.30	278	8.70	588	10.20	1,008	13.00	1,960
7.40	298	8.80	613	10.40	1,072	14.00	2,330
7.50	318	8.90	639	10.60	1,137	15.00	2,710
7.60	339	9.00	665	10.80	1,203	16.00	3,100
7.70	360	9.10	691	11.00	1,270	17.00	3,500
7.80	381	9.20	717	11.20	1,338	18.00	3,900
7.90	403	9.30	744	11.40	1,406	19.00	4,300
8.00	425	9.40	771	11.60	1,474	20.00	4,700
8.10	447	9.50	799	11.80	1,542		
8.20	469	9.60	827	12.00	1,610		
8.30	492	9.70	856	12.20	1,679		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1901 to 1908 and is well defined between gage heights 7.0 feet and 20.0 feet. Above gage height 16.0 feet the rating curve is a tangent, the difference being 40 per tenth.

Monthly discharge of Red River at Fargo, N. Dak., for 1907 and 1908.

[Drainage area, 6,020 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 18–31			2,970	0.493	0.26	82,500	B.
April			2,920	.485	.54	174,000	B.
May	1,640	1,200	1,370	.228	.26	84,200	A.
June	4,420	1,170	2,200	.365	.41	131,000	A.
July	1,370	691	1,010	.168	.19	62,100	A.
August	691	425	568	.094	.11	34,900	B.
September	515	360	428	.071	.08	25,500	B.
October	515	403	456	.076	.09	28,000	B.
November	469	220	400	.066	.07	23,800	B.
December	403		315	.052	.06	19,400	C.
The period						665,000	
1908.							
January			290	.048	.06	17,800	C.
February			250	.042	.05	14,400	C.
March			500	.083	.10	30,700	C.
April		563	1,100	.183	.20	65,500	B.
May	1,010	563	691	.115	.13	42,500	A.
June	2,600	885	1,720	.286	.32	102,000	A.
July	1,850	945	1,230	.204	.24	75,600	A.
August	945	515	696	.116	.13	42,800	A.
September	539	403	462	.077	.09	27,500	B.
October	492	381	414	.069	.08	25,500	B.
November	450		360	.060	.07	21,400	B.
December			300	.050	.06	18,400	C.
The year			668	.111	1.55	484,000	

NOTE.—Discharge estimated for March 18 to April 30, 1907, being based on three measurements. Also estimated for periods December 10, 1907, to April 6, 1908, and November 13 to December 31, 1908.

RED RIVER AT GRAND FORKS, N. DAK.

This station is located at the Northern Pacific Railway bridge between Grand Forks, N. Dak., and East Grand Forks, Minn. It was established May 26, 1901, but gage height records had been kept for many years previously at the same point by the United States Engineers, whose gage datum is precisely 5.00 feet above the datum of the

Geological Survey gage. Discharge measurements are usually made from the Great Northern Railway bridge, 1,000 feet above the gage.

The gage is one-half mile below the mouth of Red Lake River. The drainage area at this station includes about 13,420 square miles in Minnesota, 500 in South Dakota, and 11,080 in North Dakota, a total of 25,000 square miles. Red Lake River is the most important tributary, draining 5,680 square miles of the total area, and being much more steady in its flow than Red River, so that at low stages (in winter, and often in late summer and fall) Red Lake River brings from one-half to three-fifths of all the water passing this station. The datum of the gage has not been changed since its establishment. The channel is in clay and silt, and is subject to small gradual changes, but unusually precise gage records have been kept; the range of the river in height is so great—47 feet between the extremes of low and high water—that a change of 0.1 foot in gage height causes only a small percentage change in flow, and as frequent discharge measurements have been made the records are satisfactory, being as a rule excellent through the open season.

The river flows under smooth ice cover from about November 15 to April 10; the flow during the winter fluctuates little, and since 1895 enough discharge measurements have been made each winter to give fairly satisfactory summaries for the winter.

When the ice breaks up in the spring, because the river has only a gentle current and because it flows north into cooler regions where the river is not yet open, the gage reading is usually excessively and disproportionately high for a few days or weeks, so that the figures for quantity of flow must depend largely upon estimation; actual measurements when the river appeared entirely open and clear of ice at this point have sometimes shown the gage reading to be 5 feet greater than would have been needed for the same discharge later in the season, after the whole length of the river was entirely open.

Discharge measurements of Red River at Grand Forks, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 28[a]	E. F. Chandler	195	852	8.07	1,180
March 4[a]	W. H. Clark	190	930	8.18	1,220
April 8	do	550	12,400	39.25	29,400
April 22	E. F. Chandler	240	3,510	19.37	8,740
November 11[b]	do	158	934	6.81	1,670
1908.					
January 20[a]	E. F. Chandler	140	641	6.76	912
March 9[a]	do	140	686	7.76	924
March 28[a]	do	238	2,040	14.16	3,680
April 13	do	524	8,120	31.10	18,800
May 1	do	195	2,010	13.16	4,990
June 29	do	199	2,220	13.85	5,260
July 29	do	160	1,170	8.62	2,610
October 22	do	150	759	6.06	1,240

[a] Ice conditions. [b] Slush ice.

Daily gage height, in feet, of Red River at Grand Forks, N. Dak., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				30.15	15.0	11.0	12.55	8.3	6.55	9.1	6.8	.....
2			8.2	32.0	14.6	10.95	12.1	8.2	6.5	9.0	6.8	.....
3				33.65	14.15	10.65	11.75	8.05	6.4	8.8	6.9	.....
4		8.0	8.2	35.3	14.0	10.55	11.7	8.1	6.35	8.55	7.0	.....
5	8.55			37.0	13.8	10.6	11.4	8.2	6.25	8.6	6.9	.....
6				38.8	13.8	10.3	11.3	8.2	6.4	8.4	6.8	.....
7				39.8	13.7	10.3	11.05	8.2	6.5	8.2	6.9	6.2
8				39.2	13.55	10.2	11.1	8.25	6.4	8.1	6.8	.....
9		7.8	8.38	38.15	13.45	10.05	10.95	8.3	6.35	8.0	6.8	.....
10				36.65	13.15	9.9	10.8	8.2	6.4	7.9	6.9	.....
11				35.1	13.0	10.4	10.75	8.1	6.45	7.8	6.8	.....
12	8.4			33.2	12.7	11.1	10.55	8.0	6.5	7.6	6.65	.....
13				30.8	12.55	13.75	10.5	7.9	6.7	7.5	6.5	.....
14				28.8	12.4	15.9	10.4	8.0	6.8	7.5	6.1	6.4
15				26.1	12.3	18.35	10.45	7.8	6.9	7.25	6.1	.....
16		7.9	8.48	23.9	12.1	19.3	10.4	7.8	6.75	7.2	6.4	.....
17				22.0	11.95	19.75	10.2	7.7	6.6	7.2	.....	.....
18				20.8	12.0	20.35	10.2	7.6	6.5	7.2	.....	.....
19	8.4			20.1	11.8	20.3	10.0	7.6	6.5	7.2	.....	.....
20				19.35	11.65	19.8	9.9	7.5	6.75	7.2	.....	.....
21				19.35	11.5	18.9	9.8	7.4	8.35	7.2	.....	6.3
22				19.4	11.3	18.1	9.8	7.4	9.75	7.15	.....	.....
23		8.0	8.92	19.5	11.25	17.15	9.55	7.3	10.05	7.2	6.5	.....
24				19.4	11.05	16.35	9.3	7.2	10.0	7.15	.....	.....
25				19.5	11.3	15.75	9.2	7.1	9.7	7.15	.....	.....
26	8.3			18.6	11.2	14.7	9.0	7.0	9.6	7.1	.....	.....
27				17.9	11.05	13.9	8.75	6.95	9.4	6.9	.....	.....
28	8.05			17.35	10.85	13.55	8.55	6.9	9.35	6.7	.....	.....
29				16.7	10.75	12.95	8.6	6.75	9.35	6.75	.....	6.7
30			26.9	15.7	10.9	12.75	8.45	6.7	9.3	6.7	7.0	.....
31			28.4		10.95		8.35	6.65	.....	6.8	.....	.....
1908.[b]												
1		6.8		15.15	13.15	18.1	13.35	8.5	7.95	6.7	6.3	.....
2				15.25	13.05	17.9	13.05	8.6	10.75	6.75	6.3	.....
3				15.3	12.9	17.3	12.85	8.7	10.75	6.7	6.3	.....
4	6.6			15.95	12.7	16.8	12.6	8.8	9.4	6.8	6.3	.....
5				18.05	12.3	16.3	12.4	8.75	8.3	6.75	6.3	.....
6				20.25	12.05	15.4	12.1	8.6	8.35	6.75	6.3	6.1
7			7.7	24.8	11.8	14.5	11.75	8.3	7.9	6.7	6.2	.....
8		6.8		28.1	11.5	14.8	11.45	7.95	7.55	6.7	6.1	.....
9			7.75	30.7	11.15	15.95	11.25	7.9	7.2	6.7	6.25	.....
10				31.9	10.8	17.0	10.95	7.7	6.9	6.6	6.4	.....
11	6.7			32.75	10.6	17.5	10.8	7.7	6.9	6.45	6.1	.....
12				32.4	10.6	17.8	10.55	7.7	6.7	6.4	5.6	.....
13				31.3	10.45	17.85	10.3	7.7	6.6	6.45	6.1	6.3
14				29.5	10.8	17.75	10.05	7.55	6.6	6.3	5.6	.....
15		7.1	7.9	27.1	10.6	17.45	9.85	7.4	6.5	6.2	5.5	.....
16				24.9	10.9	17.3	9.6	7.4	6.5	6.4	5.7	.....
17				22.65	12.0	16.95	9.45	7.35	6.25	6.35	6.0	.....
18	6.7			20.5	12.45	16.65	9.3	7.5	6.2	6.4	6.0	.....
19				18.55	12.8	16.3	9.2	7.35	6.2	6.2	6.1	5.9
20	6.75		11.35	17.15	13.6	15.95	9.05	7.2	6.2	6.1	6.15	.....
21				15.4	14.55	15.7	8.9	7.2	6.15	6.0	6.15	.....
22		7.2		14.4	15.8	15.55	9.0	7.15	6.15	6.1	6.5	.....
23				13.6	17.6	15.35	9.05	7.05	6.2	6.3	6.7	.....
24				13.1	19.0	15.15	8.85	7.0	6.2	6.3	6.7	.....
25	6.8			12.7	19.1	14.9	8.7	6.9	6.2	6.4	6.85	.....
26				12.6	18.7	14.55	8.7	6.9	6.3	6.1	7.0	6.25
27			14.15	12.75	18.65	14.4	8.8	6.9	6.35	6.1	7.0	.....
28			14.15	13.3	18.9	14.2	8.7	6.95	6.4	6.25	6.6	.....
29		7.45		13.65	19.0	13.85	8.65	7.0	6.5	6.4	6.5	.....
30				13.65	18.9	13.65	8.5	6.9	6.65	6.4	7.0	.....
31			14.85		18.55		8.4	6.9	.....	6.3	.....	6.2

[a] River frozen January 1 to April 4, and November 17 to December 31, 1907. Considerable backwater from ice gorging during April.

[b] Ice conditions January 1 to April 4, and November 10 to December 31, 1908.

Rating table for Red River at Grand Forks, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.00	1,270	7.40	1,880	8.80	2,530	11.40	3,930
6.10	1,310	7.50	1,925	8.90	2,580	11.60	4,050
6.20	1,350	7.60	1,970	9.00	2,630	11.80	4,170
6.30	1,390	7.70	2,015	9.20	2,730	12.00	4,290
6.40	1,430	7.80	2,060	9.40	2,830	13.00	4,920
6.50	1,475	7.90	2,105	9.60	2,930	14.00	5,600
6.60	1,520	8.00	2,150	9.80	3,030	15.00	6,300
6.70	1,565	8.10	2,195	10.00	3,140	16.00	7,030
6.80	1,610	8.20	2,240	10.20	3,250	17.00	7,800
6.90	1,655	8.30	2,285	10.40	3,360	18.00	8,600
7.00	1,700	8.40	2,330	10.60	3,470	19.00	9,430
7.10	1,745	8.50	2,380	10.80	3,580	20.00	10,300
7.20	1,790	8.60	2,430	11.00	3,690	21.00	11,190
7.30	1,835	8.70	2,480	11.20	3,810		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 8 discharge measurements made during 1907 to 1909 and the form of the 1906 curve. It is well defined.

Monthly discharge of Red River at Grand Forks, N. Dak., for 1907 and 1908.

[Drainage area, 25,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January			1,400	0.056	0.06	86,100	C.
February			1,090	.044	.05	60,500	C.
March	14,700	1,210	3,070	.123	.14	189,000	D.
April	29,400	7,320	14,800	.592	.66	881,000	B.
May	6,300	3,550	4,550	.182	.21	280,000	A.
June	10,600	3,080	6,000	.240	.27	357,000	A.
July	4,630	2,310	3,290	.132	.15	202,000	A.
August	2,280	1,540	2,000	.080	.09	123,000	A.
September	3,170	1,370	1,950	.078	.09	116,000	A.
October	2,680	1,560	1,970	.079	.09	121,000	A.
November	1,700		1,440	.058	.06	85,700	B.
December			1,200	.048	.06	73,800	C.
The year			3,560	.143	1.93	2,580,000	
1908.							
January			890	.036	.04	54,700	C.
February			800	.032	.03	46,000	C.
March			1,960	.078	.09	121,000	C.
April	20,500		9,850	.394	.44	586,000	B.
May	9,520	3,390	5,790	.232	.27	356,000	A.
June	8,680	5,360	7,140	.286	.32	425,000	A.
July	5,150	2,330	3,290	.132	.15	202,000	A.
August	2,530	1,660	1,970	.079	.09	121,000	A.
September	3,550	1,330	1,760	.070	.08	105,000	A.
October	1,610	1,270	1,440	.058	.07	88,500	A.
November	1,390		1,250	.050	.06	74,400	C.
December			830	.033	.04	51,000	C.
The year			3,080	.123	1.68	2,230,000	

NOTE.—Ice conditions January 1 to April 4 and November 17 to December 31, 1907; January 1 to April 4 and November 10 to December 31, 1908. There was considerable backwater due to ice gorging during April, 1907. Discharges for ice periods have been estimated on the basis of ice measurements made.

22110—IRR 245—10——4

SHEYENNE RIVER AT HAGGART, N. DAK.

This station is located at a private wagon bridge about one-fourth mile north of the railway at Haggart, on the Northern Pacific Railway, 6 miles west of Fargo, N. Dak. The station was established March 22, 1902, and discontinued July 1, 1907.

Sheyenne River rises in the central portion of North Dakota, 175 miles northwesterly from this station, and flows easterly, passing only a few miles south of Devils Lake and Stump Lake. These are now inland basins, but in recent geologic times of greater precipitation they overflowed and drained regularly into Sheyenne River. At this point the river turns south, then around in a wide curve to the east, and then north to the station, and empties into the Red River 10 miles below this station. The length along the general course of its valley is 330 miles. Its most important tributary, Maple River, is received 3 miles below this station.

The theoretical drainage area above the mouth of the Sheyenne River is about 6,930 square miles, and above this station is about 5,400 square miles. But the whole basin is within the glacial area of rolling prairie, drift covered in irregular slopes and ridges with imperfect drainage systems, so that it is probable that there is half to three-fourths of the entire drainage area from which no water ever reaches the river except in years of unusually large or sudden rainfall.

There has been no change in the gage datum. The station conditions, such as the sluggish character of the stream and large effect therefore caused by small temporary obstructions, the silting channel, and the possible occasional effect of backwater from the inflow of the Maple River 3 miles below, make it impossible to maintain precise records without frequent measurements, but the summaries are fairly correct.

The following discharge measurement was made April 8, 1907:

Width, 67 feet; area, 346 square feet; gage height, 9.31 feet; discharge, 652 second-feet. Ice was running at the time of measurement.

Daily gage height, in feet, of Sheyenne River at Haggart, N. Dak., for 1907.

Day.	April.	May.	June.	Day.	April.	May.	June.	Day.	April.	May.	June.
1	18.2	7.0	5.6	11	9.1	7.4	5.3	21	6.4	6.4	5.8
2	17.6	7.4	5.5	12	8.5	7.3	5.6	22	6.4	6.4	5.7
3	15.2	7.7	5.4	13	8.2	7.1	6.0	23	6.4	6.4	5.6
4	13.8	8.2	5.4	14	7.6	7.0	6.0	24	6.3	6.3	5.5
5	11.2	8.4	5.3	15	7.2	6.7	5.7	25	6.3	6.3	5.4
6	9.8	8.4	5.3	16	6.7	6.7	5.6	26	6.3	6.2	5.4
7	9.8	8.3	5.3	17	6.6	6.6	5.4	27	6.3	6.2	5.3
8	9.4	8.1	5.2	18	6.5	6.6	5.5	28	6.3	6.1	5.3
9	9.4	7.7	5.2	19	6.5	6.5	5.7	29	6.3	6.1	5.3
10	9.3	7.5	5.1	20	6.4	6.5	5.8	30	6.5	6.0	5.2
								31		5.7	

NOTE.—Floating ice from April 1 to 8.

Rating table for Sheyenne River at Haggart, N. Dak., for 1905 to 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
5.00	200	5.30	233	5.60	269
5.10	211	5.40	245	5.70	281
5.20	222	5.50	257		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1902 to 1906 and is fairly well defined. Above gage height 5.7 feet the rating curve is a tangent, the difference being 13 per tenth.

Monthly discharge of Sheyenne River at Haggart, N. Dak., for 1907.

[Drainage area, 5,400 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April		359	592	0.110	0.12	35,200	B.
May	632	281	442	.082	.09	27,200	A.
June	320	211	255	.047	.05	15,200	A.

DEVILS LAKE AT DEVILS LAKE, N. DAK.

Devils Lake, in the north-central portion of North Dakota, offers an interesting example of the rainfall-evaporation-run-off ratio. This lake has no outlet, its surface elevation depending entirely upon the relation between evaporation from its surface, the rainfall upon it, and inflow from the surrounding country.

On the south the lake is bordered by hills 100 to 200 feet in height, and it is not far to the divide between the Devils Lake drainage area and the valley of Sheyenne River, which flows nearly parallel to the lake on the south at a distance of 6 to 12 miles. On the north a gently rolling prairie rises gradually, and on the northwest no other drainage area is reached for a distance of more than 50 miles. The total area draining to Devils Lake is theoretically somewhat more than 1,900 square miles.

This area is all included within the region covered by glacial drift; and small lakes, hollows, and pools are thickly scattered over it. The fall is slight, nearly the whole area being included between the elevations of 1,440 and 1,600 feet above sea level. The rainfall is but little in excess of the evaporation, the total run-off for the entire year as found at river stations in this State being rarely more than 2 inches, and often only a fraction of 1 inch, as computed from the theoretical drainage areas. With so small run-off and so small fall, the drainage channels and river systems are therefore as yet very imperfectly developed. Much of the water that runs into the small lakes or co[illegible]es is held there until it evaporates, and from large por-

tions of the total drainage area no water ever reaches Devils Lake except in years of exceptionally great or sudden rainfall. The area which actually drains into Devils Lake in ordinary years is probably not more than a third or a half of the theoretical 1,900 square miles.

When the region was first settled, about twenty-five years ago, the surveys showed Devils Lake to have a total length of 35 miles, a width ranging from 1 mile to 15 miles, and an area of approximately 120 square miles; on account of its many bays and slender arms, the total shore line measured more than 200 miles. With settlement and the conversion into farms of the prairies formerly tenanted by vast herds of buffalo, the sod was broken, the soil cultivated, and the flow of rainfall from its surface retarded. The lake thus lost a large portion of its annual supply, and its level was continuously lowered by evaporation, until the reduction in surface area had brought the evaporation to equality with the inflow. The present area of the lake is not precisely known, but is estimated as not more than a half of the 120 square miles formerly seen. The lake seems to be now approximately in a condition of equilibrium, which ought to be maintained unless some change in the extent or method of agriculture should use still more fully the water that otherwise would run into the lake from the surrounding country.

It is a shallow lake, the greatest depth found at present stage being said to be only about 30 feet. Many old beaches are seen surrounding it at elevations of from 15 to 30 feet above the present surface; at a still farther elevation of a few feet, it is said that the lake would overflow the rim of its basin at the eastern end and find outlet into Stump Lake or Sheyenne River. It is certain that the lake had an outlet in some direction in quite recent geologic times, for the waters, though quite saline and brackish, have as yet small solid content compared with many such lakes, containing slightly more than 1 per cent by weight of the salts of sodium, calcium, and magnesium, or only one-third as much as ordinary sea water.

Since June 8, 1901, a gage has been maintained on Devils Lake by the United States Geological Survey, the same being a staff gage attached to the piles of the pier at the Chautauqua grounds steamer landing, 6 miles southwest of the city of Devils Lake. This gage is read occasionally by Capt. E. E. Heerman.

A standard United States Geological Survey bench mark post is set in the bank directly behind the gage and about 8 rods distant. The gage zero is 1,416.2 feet above sea level, and the bench mark is 22.90 feet above the gage zero.

Descriptions of this station were published with some records, in Water-Supply Papers No. 66, page 14, and No. 85, page 238, except that the elevation of the bench mark above the gage zero as previously published is in error.

The normal rainfall over the area draining into Devils Lake is between 15 and 18 inches a year, according to the more or less extended records of Weather Bureau stations, five in number, in or at the margins of the area, taken in comparison with others near by in adjoining areas. At each of these stations nearly complete rainfall records have been at some time maintained for a period of at least ten years.

The list of observed gage heights of the water surface of the lake since the establishment of the gage, with a few fairly well authenticated previous records, is given below:

Gage height, in feet, of Devils Lake near Devils Lake, N. Dak.

Date.	Gage height.	Date.	Gage height.
	Feet.	1904—	*Feet.*
1867	26.75	April 24	12.7
1879	22.9	April 30	12.8
1896, August	13.0	May 1	12.7
1901—		May 5	12.75
June 7	12.15	May 11	12.8
June 8	12.4	May 17	13.2
June 23	12.35	June 8	13.4
June 27	12.25	June 26	13.4
August 17	12.05	July 5	13.4
September 14	11.9	August 23	13.0
September 19	11.65	September 6	13.0
September 26	12.15	October 3	12.8
October 8	12.1	October 10	12.75
October 21	12.05	November 29	12.65
1902—		1905—	
April 25	13.55	July 15	13.3
April 30	13.6	July 16	13.5
May 5	13.8	November 29	12.65
May 7	13.85	1906—	
May 24	13.95	April 8	12.8
June 5	14.0	May 6	12.65
June 10	13.95	June 7	13.0
June 13	14.1	June 21	12.95
June 22	14.0	July 8	13.0
June 27	13.95	August 22	12.4
July 15	13.7	September 24	12.15
August 7	13.5	October 11	11.85
August 23	13.7	November 16	11.6
September 13	13.2	1907—	
September 28	13.2	May 7	12.35
October 12	13.1	June 2	12.35
October 22	13.05	July 1	12.4
November 15	13.0	July 9	12.5
1903—		July 17	12.3
May 29	13.1	August 1	12.1
June 5	13.1	August 8	11.95
June 13	13.1	August 28	11.8
June 17	12.9	November 15	11.3
June 26	12.8	1908—	
July 6	12.6	April 21	11.7
July 10	12.55	June 27	11.35
July 19	12.4	July 12	11.3
July 25	12.3	July 17	11.2
August 15	12.2	August 3	11.1
August 25	12.1	August 12	10.9
August 29	12.2	August 20	10.8
September 10	12.1	August 29	10.7
October 27	11.9	November —	10.2
November 15	11.75		

The gage height at the close of the season of 1908 is the lowest ever recorded, being 1.10 feet below the record of the lowest preceding year. This was due, at least in part, to the unusually small rainfall in the drainage area of Devils Lake during 1908. But the drainage

area has during the past two years been more fully opened to settlement than before, and much new prairie has been broken; it is therefore reasonable to suppose that this will cause permanently a small decrease in the run-off, so that the lake will never entirely regain its former height, unless in a year of abnormally great rainfall.

RED LAKE RIVER AT CROOKSTON, MINN.

This station is located at Crookston, Minn., at the "Sampson's Addition" bridge, one block west of the Great Northern Railway depot. It was established May 19, 1901.

This river is the most important tributary of the Red. The station record has great value in connection with questions of flood damages or navigation on Red River, is necessary to determine the value of the water powers on the main stream and its tributaries, and will show the effect of drainage-ditch construction on the river regimen.

The drainage area above the station is about 5,520 square miles, of which 1,980 square miles lie above the outlet of Red Lake. This is the largest fresh-water lake wholly within the United States, and has an area of 441 square miles. From this portion of the whole drainage area the run-off is therefore very steady. By dredging the outlet, it is possible to use the lake for storage, if it should be profitable.

Red Lake River is a logging stream, and subject to brief abrupt variations when the logs are being sluiced down, but as all the mills are above the station at Crookston, except one at East Grand Forks, which is 25 miles below, the log jams never interfere with the station records.

The station is one-eighth mile below the power house of the Crookston Light, Water and Power Company, through the wheels of which the entire daily flow at low stages passes in about half of the day. At such times the sudden opening or closing of the gates at the mill causes abrupt changes in gage height at the station; but as the gage is read several times daily, it is not supposed that these fluctuations often affect seriously the daily mean.

There has been no change in gage datum nor appreciable change in channel conditions since the establishment of the station, and the open-season records are excellent.

The power-house dam above the station causes the river to remain partially open at the gage through most of the winter in some years, but within a short distance below it freezes smoothly over for about four months. Since 1906, winter discharge measurements have also been made, so that fair estimates of winter flow have been deduced.

Discharge measurements of Red Lake River at Crookston, Minn., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 11[a]	E. F. Chandler	178	288	5.26	458
March 18[a]	do	174	426	5.98	648
August 3	Follansbee and Chandler	173	297	4.15	612
November 18[b]	E. F. Chandler	158	334	4.45	621
1908.					
February 10[a]	E. F. Chandler	138	379	5.99	607
February 24[a]	do	138	325	5.52	408
June 25	do	182	911	7.50	2,640
December 23[a]	do	150	331	4.54	495

[a] Measurements through ice. [b] Ice conditions.

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	5.6			9.2	7.5	5.85	5.9	4.75	4.3	5.05	4.7	4.25
2				9.4	7.55	5.8	5.9	4.5	4.2	5.3	4.7	4.5
3				10.85	7.35	5.95	5.85	4.6	4.3	5.4	4.6	4.7
4				11.95	7.35	5.65	6.2	4.95	4.2	5.35	4.65	4.6
5				11.9	7.35	5.65	5.8	4.8	4.1	5.15	4.75	4.45
6				11.7	7.45	5.65	5.95	5.0	4.65	5.0	4.6	4.5
7	5.6			11.65	7.2	5.6	5.9	5.0	4.55	5.2	4.6	5.0
8				11.2	6.9	5.45	6.0	5.0	4.7	5.1	4.7	4.2
9	5.6			10.9	7.1	5.6	5.75	5.0	4.55	5.05	4.65	4.8
10				10.15	6.9	5.9	5.55	5.0	4.45	5.0	4.4	4.6
11		5.26		10.1	6.7	6.5	5.1	4.8	4.35	5.0	4.25	4.8
12				9.65	6.6	8.45	5.3	4.8	4.4	5.0	4.05	4.8
13				9.35	6.75	8.9	5.0	4.5	4.4	4.7	3.95	4.65
14				8.9	6.9	8.6	4.7	4.4	4.45	5.1	3.95	5.0
15				9.15	6.45	8.3	4.95	4.4	4.25	4.85	3.8	4.95
16				9.2	6.55	7.75	5.3	4.75	4.4	4.75	3.8	4.85
17				9.0	6.6	8.55	5.0	4.5	4.3	4.9	4.3	4.55
18			6.1	9.7	6.4	8.2	5.0	4.3	4.8	4.85	4.4	4.45
19			6.3	8.8	6.4	7.7	4.5	4.4	4.1	4.9	4.1	4.75
20				9.5	6.45	6.95	5.25	4.4	5.25	4.7	4.1	4.8
21			6.2	9.4	5.95	6.75	4.85	4.4	5.35	4.9	4.2	4.95
22			6.3	9.55	6.15	6.6	5.0	4.45	5.85	4.9	4.25	4.5
23			6.4	11.2	5.9	6.8	4.55	4.6	5.75	4.8	4.5	5.2
24			6.7	9.8	6.4	6.7	4.9	4.4	5.9	4.7	4.4	4.8
25			8.35	8.75	6.3	6.7	4.9	4.4	5.85	4.5	4.5	4.5
26			8.9	8.25	5.9	6.6	4.8	3.9	5.3	4.7	4.45	5.4
27			8.4	7.8	6.2	6.4	4.8	4.45	5.8	4.6	4.55	4.9
28			10.35	7.4	6.1	6.3	4.95	4.4	5.3	4.5	3.9	5.05
29			9.85	7.5	6.05	6.15	5.0	4.4	5.4	4.75	4.55	4.3
30			9.2	7.4	5.85	6.0	4.85	4.3	5.0	4.65	4.35	5.2
31			8.65	.....	6.15	.....	4.6	4.1	.....	4.7	.....	4.9
1908.[b]												
1	4.7	5.2	.....	6.5	7.65	10.0	6.25	5.4	8.55	4.8	4.4	3.8
2	4.9	5.0	5.6	6.5	7.6	9.8	6.2	5.0	7.7	4.8	4.1	4.0
3	4.95	5.2	5.7	6.6	7.5	9.5	6.2	5.45	6.8	.....	4.7	4.0
4	5.0	.....	5.5	6.8	7.3	9.1	6.15	5.45	5.85	4.75	4.7	3.8
5	4.95	5.3	5.6	11.9	7.3	8.0	5.9	5.4	5.9	4.7	4.4	3.6
6	5.2	5.3	5.5	14.7	7.1	7.85	5.95	5.4	5.6	4.8	4.7	3.3
7	5.1	.....	.....	16.6	7.1	8.4	5.5	5.2	5.4	4.75	4.7	3.8
8	4.8	.....	.....	15.95	6.8	9.0	5.9	5.05	5.05	4.7	4.5	3.8
9	5.4	.....	.....	15.75	6.6	8.9	5.8	4.7	4.9	4.55	4.55	3.85
10	5.4	6.0	5.7	15.8	6.45	8.15	5.45	4.9	5.0	4.5	4.5	4.2
11	5.5	.....	5.4	14.65	6.6	8.4	5.8	4.8	4.75	4.4	4.5	4.2
12	4.55	.....	5.5	15.1	6.75	8.35	5.2	5.0	4.8	4.4	4.5	4.05
13	5.0	.....	5.5	11.7	7.45	8.15	5.4	4.8	4.45	4.4	4.5	4.05
14	5.0	.....	5.8	11.6	7.7	7.95	5.4	4.7	4.65	4.6	4.5	4.05
15	5.05	.....	5.7	11.4	7.9	7.9	5.25	4.95	4.6	4.65	4.5	3.1

[a] Ice conditions January 1 to about March 31 and November 15 to December 31, 1907.
[b] Ice conditions, or partial ice conditions, January 1 to April 5 and November 9 to December 31, 1908.

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16	5.05	.....	5.5	11.1	7.8	7.8	5.25	5.4	4.75	4.1	4.5	4.35
17	5.05	6.2	5.7	10.35	8.0	7.8	5.35	4.9	4.6	4.6	4.5	4.2
18	5.05	.....	.....	9.2	8.1	7.65	5.1	4.9	4.4	4.4	4.5	4.3
19	5.10	.....	6.0	8.65	9.2	7.7	5.1	4.9	4.45	4.65	4.5	4.45
20	5.15	.....	5.8	7.85	9.85	7.3	5.0	5.0	4.45	4.3	4.5	4.3
21	5.15	.....	6.0	7.35	10.2	7.6	5.15	4.85	4.55	4.4	4.5	4.5
22	5.15	.....	6.1	7.0	12.1	7.6	5.2	4.95	4.6	4.9	4.4	4.55
23	5.15	.....	.....	6.9	12.2	7.5	5.2	4.95	4.55	4.5	4.4	4.55
24	5.15	5.5	.....	6.65	12.1	7.3	5.15	5.0	4.6	4.55	4.4	4.5
25	4.85	5.52	6.2	6.9	10.9	7.4	5.1	4.55	4.6	4.0	4.4	4.5
26	5.0	.....	6.3	7.3	11.1	7.2	4.8	5.2	4.7	4.85	4.4	4.55
27	5.0	.....	6.4	8.0	11.35	7.0	5.4	5.0	4.75	4.5	4.4	4.2
28	5.1	5.55	6.3	8.15	11.15	6.7	4.95	5.15	4.9	4.7	4.4	4.7
29	5.15	.....	6.4	7.7	10.85	6.5	5.2	5.25	4.85	4.7	4.4	4.7
30	5.15	.....	6.4	7.4	10.55	6.3	5.0	5.2	4.8	4.65	4.4	4.9
31	.....	.....	6.5	.....	10.4	.....	5.15	8.3	.....	4.6	.....	4.8

Rating table for Red Lake River at Crookston, Minn., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	475	5.20	1,203	6.60	2,046	9.00	3,840
3.90	515	5.30	1,260	6.70	2,112	9.20	4,000
4.00	560	5.40	1,317	6.80	2,180	9.40	4,160
4.10	605	5.50	1,374	6.90	2,250	9.60	4,320
4.20	655	5.60	1,432	7.00	2,320	9.80	4,480
4.30	705	5.70	1,491	7.20	2,464	10.00	4,640
4.40	760	5.80	1,550	7.40	2,610	11.00	5,460
4.50	815	5.90	1,610	7.60	2,758	12.00	6,300
4.60	870	6.00	1,670	7.80	2,908	13.00	7,150
4.70	925	6.10	1,731	8.00	3,060	14.00	8,000
4.80	980	6.20	1,792	8.20	3,216	15.00	8,900
4.90	1,035	6.30	1,854	8.40	3,372	16.00	9,800
5.00	1,090	6.40	1,917	8.60	3,528	17.00	10,700
5.10	1,146	6.50	1,981	8.80	3,684		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1908 and is well defined.

Monthly discharge of Red Lake River at Crookston, Minn., for 1907 and 1908.

[Drainage area, 5,520 square miles.]

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
1907.							
January	.....	.....	650	0.118	0.14	40,000	C.
February	.....	.....	460	.083	.09	25,500	C.
March	.....	.....	1,280	.232	.27	78,700	C.
April	6,260	2,610	4,370	.792	.88	260,000	A.
May	2,720	1,580	2,080	.377	.43	128,000	A.
June	3,760	1,350	2,180	.395	.44	130,000	A.
July	1,790	815	1,220	.221	.25	75,000	A.
August	1,090	515	854	.155	.18	52,500	A.
September	1,610	605	994	.180	.20	59,100	A.
October	1,320	815	1,040	.188	.22	64,000	A.
November	952	.....	668	.121	.14	39,700	C.
December	.....	.....	626	.113	.13	38,500	C.
The year	6,260	.....	1,370	.248	3.37	991,000	

Monthly discharge of Red Lake River at Crookston, Minn., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
January			467	.085	.10	28,700	C.
February			508	.092	.10	29,200	C.
March			620	.112	.13	38,100	C.
April	10,300		4,660	.844	.94	277,000	B.
May	6,470	1,950	3,750	.679	.78	231,000	A.
June	4,640	1,850	3,050	.553	.62	181,000	A.
July	1,820	980	1,340	.243	.28	82,400	A.
August	3,290	842	1,190	.216	.25	73,200	A.
September	3,490	760	1,180	.214	.24	70,200	A.
October	1,040	605	860	.156	.18	52,900	A.
November			803	.145	.16	47,800	C.
December			437	.079	.09	26,900	C.
The year	10,300		1,570	.285	3.87	1,140,000	

NOTE.—Ice conditions existed, January 1 to March 25 and November 15 to December 31, 1907; from January 1 to April 5 and November 9 to December 31, 1908. Discharge for ice periods has been estimated from occasional measurements and some gage heights and is only fair.

PEMBINA RIVER AT NECHE, N. DAK.

This station, which was established April 29, 1903, is located at the Great Northern Railway bridge, two-thirds mile north of Neche, N. Dak. Discharge measurements are made from the highway bridge, 20 rods below.

The records of this stream are necessary to determine the value of the many water-power sites on the Pembina, and are valuable in connection with problems of navigation and flood damages on Red River and in drainage investigations.

The total drainage area above this station is about 2,940 square miles, of which 2,020 are in Manitoba, as the stream rises in Manitoba, and flows for about 90 miles close to and nearly parallel with the international boundary, before crossing into North Dakota, 50 miles above its mouth at Pembina.

A loose-rock dam, about 3 feet high, at the railway water-tank intake pipe, one-third mile below the gage, raises the water at the gage from 1 to 2 feet at low stage. As the dam is changed somewhat by the ice each spring, the lower portion of the rating curve requires revision each year. Hence, unless several low-stage discharge measurements are made each season the summaries for the low-water season are merely approximate or fair. The gage datum has not been changed, and the curve for high stage remains constant.

Discharge measurements of Pembina River at Neche, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 13	E. F. Chandler	86	886	13.08	1,940
July 13	do	65	168	3.68	159
August 2	Follansbee and Chandler	52	113	2.72	75
September 14	E. F. Chandler	65	168	3.46	36
Do[a]	do	44	43	3.46	37
1908.					
January 27	E. F. Chandler	39	11.7	2.13	3.8
April 3[b]	do			3.40	3.0
June 24	do	66.5	172	4.13	191
July 24[a]	do	55	54	3.18	53
Do	do	59.5	110	3.18	51

[a] Wading measurements. [b] Ice conditions, and discharge estimated.

Daily gage height, in feet, of Pembina River at Neche, N. Dak., for 1907 and 1908.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.[a]								
1		12.9	7.0	4.3	2.85	3.45	3.45	3.7
2		12.75	6.9	4.3	2.8	3.45	3.45	3.65
3		12.75	6.6	4.35	2.8	3.45	3.5	3.65
4		12.1	6.5	4.3	2.7	3.45	3.5	3.65
5		10.5	6.5	4.2	2.65	3.45	3.5	3.65
6		10.5	6.4	4.15	2.65	3.45	3.55	3.65
7		10.9	6.2	4.0	2.6	3.45	3.55	3.65
8		11.6	6.0	3.95	2.65	3.35	3.5	3.45
9		12.05	5.9	3.9	2.6	3.35	3.55	3.45
10		12.6	5.9	3.9	2.5	3.35	3.6	3.45
11		13.2	5.9	3.85	2.35	3.35	3.6	3.45
12		13.15	5.95	3.8	2.3	3.35	3.6	3.45
13		13.1	5.9	3.7	2.25	3.35	3.65	.....
14		13.6	5.8	3.6	2.55	3.3	3.65	.....
15		13.0	5.6	3.5	2.5	3.35	3.65	.....
16		12.1	5.55	3.55	2.5	3.4	3.65	.....
17		11.85	5.5	3.5	2.5	3.4	3.65	.....
18		11.6	5.4	3.45	2.4	3.4	3.65	.....
19		11.0	5.3	3.3	2.35	3.4	3.65	.....
20		10.6	5.2	3.25	2.3	3.55	3.65	.....
21	4.05	10.0	5.1	3.2	2.3	3.5	3.65	.....
22	4.05	9.8	5.05	3.2	[b]3.3	3.5	3.65	.....
23	4.7	9.4	4.9	3.25	3.3	3.5	3.65	.....
24	5.85	9.0	4.8	3.2	3.3	3.5	3.65	.....
25	5.9	8.7	4.7	3.1	3.35	3.5	3.65	.....
26	7.0	8.4	4.5	3.1	3.3	3.5	3.7	.....
27	8.9	8.0	4.4	3.1	3.35	3.5	3.7	.....
28	10.8	7.6	4.35	3.0	3.4	3.5	3.7	.....
29	12.2	7.5	4.3	2.95	3.45	3.5	3.7	.....
30	12.4	7.2	4.3	2.9	3.45	3.5	3.7	.....
31	.....	7.1	.....	2.8	3.45	.....	3.7	.....

[a] Ice broke up April 27, 1907; river frozen November 8 to December 31, 1907.
[b] Dam rebuilt and raised, August 22, 1907.

Daily gage height, in feet, of Pembina River at Neche, N. Dak., for 1907 and 1908—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1908.[a]								1908.[a]							
1	.....	4.85	5.6	3.8	3.0	3.3	3.2	16	4.7	5.85	4.0	3.45	3.2	3.25	.....
2	.....	4.85	5.5	3.8	3.0	3.3	3.2	17	4.7	5.85	3.95	3.4	3.25	3.25	4.4
3	3.4	4.8	5.4	3.8	3.05	3.3	3.1	18	4.7	5.8	3.95	3.35	3.2	3.25	4.4
4	.....	4.8	5.25	3.75	3.1	3.25	3.1	19	4.7	5.8	3.95	3.3	3.2	3.25	4.4
5	3.9	4.8	5.0	3.75	3.1	3.25	3.15	20	4.7	5.8	3.9	3.3	3.2	3.25	4.4
6	3.9	4.75	4.9	3.75	3.1	3.25	3.1	21	4.65	5.75	3.9	3.3	3.25	3.25	4.45
7	5.9	4.85	4.8	3.75	3.05	3.2	3.2	22	4.65	5.75	3.9	3.3	3.2	3.25	4.45
8	6.95	4.95	4.65	3.7	3.0	3.2	3.15	23	4.6	5.7	3.9	3.3	3.15	3.25	4.4
9	7.0	5.5	4.45	3.7	3.0	3.2	3.1	24	4.9	5.7	3.9	3.2	3.15	3.25	4.4
10	7.7	5.6	4.3	3.7	3.0	3.2	3.1	25	5.2	5.7	3.85	3.2	3.15	3.4	4.45
11	7.0	6.1	4.15	3.65	3.3	3.2	[b] 4.1	26	5.3	5.75	3.85	3.1	3.15	3.4	4.45
12	6.5	6.0	4.05	3.65	3.3	3.2	4.1	27	5.1	5.8	3.85	3.1	3.2	3.3	4.45
13	6.0	5.9	4.0	3.6	3.3	3.2	4.1	28	5.0	5.9	3.8	3.1	3.2	3.3	4.45
14	5.7	5.85	4.0	3.55	3.3	3.2	4.1	29	4.9	5.75	3.8	3.05	3.25	3.3	4.4
15	5.5	5.85	4.0	3.5	3.25	3.25	4.4	30	4.85	5.7	3.8	3.05	3.3	3.2	4.4
								31	.....	5.7	.....	3.0	3.3	.....	4.4

[a] Ice conditions January 1 to April 5 and November 8 to December 31, 1908.
[b] Dam raised October 11, 1908.

Rating tables for Pembina River at Neche, N. Dak.

APRIL 20 TO AUGUST 21, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	49	3.30	115	4.30	263	5.30	455
2.40	54	3.40	125	4.40	282	5.40	475
2.50	59	3.50	136	4.50	301	5.50	495
2.60	64	3.60	148	4.60	320	5.60	515
2.70	70	3.70	161	4.70	339	5.70	535
2.80	76	3.80	176	4.80	358	5.80	555
2.90	83	3.90	192	4.90	377	5.90	575
3.00	90	4.00	209	5.00	396	6.00	595
3.10	98	4.10	227	5.10	415		
3.20	106	4.20	245	5.20	435		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and form of previous curves, and is well defined. Above gage height 6 feet the rating curve is a tangent, the difference being 21 per tenth.

AUGUST 22 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	23	3.50	41	3.60	53	3.70	66
3.40	31						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during above period and form of previous curves, and is not well defined.

JANUARY 1 TO OCTOBER 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	36	3.60	105	4.20	204	4.80	320
3.10	45	3.70	120	4.30	222	4.90	340
3.20	55	3.80	136	4.40	241	5.00	360
3.30	66	3.90	152	4.50	260		
3.40	78	4.00	169	4.60	280		
3.50	91	4.10	186	4.70	300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and form of previous curve, and is well defined. Above gage height 5 feet the rating curve is a tangent, the difference being 21 per tenth.

Monthly discharge of Pembina River at Neche, N. Dak., for 1907 and 1908.

[Drainage area, 2,940 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 21-30			860	0.293	0.11	17,100	C.
May	2,190	826	1,600	.544	.63	98,400	B.
June	805	263	507	.172	.19	30,200	B.
July	272	76	156	.053	.06	9,590	B.
August[a]	80	36	54.3	.014	.02	3,340	B.
September	47	23	34.8	.012	.01	2,070	C.
October	66	36	55.2	.019	.02	3,390	C.
November			38.0	.013	.01	2,260	D.
December			19.0	.006	.01	1,170	D.
The period						168,000	
1908.							
January			6	.002	.002	369	
February			3	.001	.001	173	
March			3	.001	.001	184	
April	927		375	.128	.14	22,300	B.
May	591	310	474	.161	.19	29,100	B.
June	486	136	224	.076	.08	13,300	B.
July	136	36	87.8	.030	.03	5,400	B.
August	66	36	52.1	.018	.02	3,200	B.
September	78	55	60.9	.021	.02	3,620	C.
October 1-10	55	45	49.0	.017	.006	972	C.
The period						78,600	

[a] Discharge corrected August 22 to 28, 1907, for effect of construction work on dam.

NOTE.—Discharge estimated for April 21-30, 1907, when ice was breaking up. Also estimated for period November 1, 1907, to April 4, 1908, being based on one measurement and an estimated measurement. The discharge January 1 to April 4, 1908, is only a rough approximation and is given merely to indicate in a general way the relatively low flow which probably occurred during this period.

MOUSE RIVER AT MINOT, N. DAK.

The Mouse (or Souris) River rises in the southeastern part of the province of Assiniboia, Canada, and flows southeastward 150 miles to the northern boundary of North Dakota; thence it continues in a southeasterly direction for 80 miles to the southwestern part of McHenry County, thence northeast 40 miles, thence it completes a loop by swinging to the north and northwest, and in 50 miles reaches the Canadian boundary again. Thence it flows north and east 120 miles through the province of Manitoba to Assiniboine River, which discharges into Red River 120 miles farther east, at Winnipeg.

The drainage area above the point where the river enters the United States is about 7,200 square miles, nine-tenths of this area being in Assiniboia and the remainder a narrow strip along the northern edge of North Dakota. Above the point where the river leaves the United States the total drainage area is about 12,000 square miles.

The Mouse has only three important tributaries in North Dakota—Des Lacs River, draining about 700 square miles, and Cut Bank and

Willow creeks, draining each about 1,100 square miles. All these streams flow from a rolling prairie whose surface was left uneven by the ice of the glacial epoch and whose drainage is imperfectly developed. Hence in ordinary years the run-off from only a small portion of the drainage area, perhaps one-fourth, reaches the streams, but the water stands in scattered pools and lakelets that dry away through the season. In unusually wet or stormy years, these pools and sloughs overflow, causing abnormal increases in the flow of the river.

The whole area is deeply covered with glacial drift, except a portion of the "Mouse River loop," which is covered with silt and is more level, having been in the glacial epoch the bottom of Lake Souris, an arm of Lake Agassiz, which filled the Red River valley at that time.

The elevation of this drainage basin is 1,450 feet above sea level at the lowest point in North Dakota and about 2,000 feet at its western margin in North Dakota.

In the upper portion of its course the river occupies a valley a hundred feet deep and a mile wide; after turning north around the loop, it runs through a prairie scarcely above the water level. The whole stretch in North Dakota is very sluggish on account of its small fall, and in the last 40 miles before the river reenters Canada its total fall is only 8 feet.

The area is without forests or trees except small scattered clumps or groves on the steep hillsides and fringes along the streams. The mean annual rainfall is from 13 to 17 inches, half of which falls in the three months of May, June, and July.

During the winter the streams are closed for at least four months, and the flow beneath the ice is very small. Thaws sufficient to cause any considerable rise or flood in winter are unknown.

The stations in the Mouse River basin were established to determine the possibility of irrigation, and the records have shown that (except in years so wet that the irrigation would be of little value) the flow of the streams is too small to justify as expensive construction as would be necessary for extensive irrigation works in a country of such small slope. The station records are now found to be essential for investigating the methods of reclamation by drainage in the Mouse River loop, and for flood prevention.

The tributaries present some storage possibilities, as, for example, at Des Lacs Lakes on Des Lacs River, but losses by evaporation would be so great that this storage would probably be useless except for flood prevention.

The gaging station, which is located north of the Great Northern Railway roundhouse, at Minot, N. Dak., was established May 5, 1903.

Des Lacs River enters 7 miles above the station.

The gage datum has not been changed, and channel conditions remain nearly constant, but the gage height at low stage is controlled by a 3-foot dam at the Soo Railway water tank, a mile below the gage, which at extreme low water raises the water at the gage about 2 feet. The dam was rebuilt and changed during the summer of 1904, but has since been unchanged. It is a tight plank dam with level crest, to which weir formulas have been found to apply satisfactorily, so that a very good rating curve for all ordinary stages has been developed, and the monthly discharge is accurate.

Discharge measurements of Mouse River at Minot, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	E. F. Chandler	109	850	11.23	1,360
May 27	do	174	1,490	15.88	2,170
July 1	do	86	386	6.61	672
August 6	do	76	214	4.50	149
December 21 [a]	do	42	50	3.80	9.6
1908.					
May 30	E. F. Chandler	77.5	226	4.67	172
Do [b]	do	57.5	89	4.67	156
October 11 [b]	do	48	40	3.82	13.1
Do [b]	do	26	11.4	3.82	11.7

[a] River frozen at point of measurement, but clear at gage. [b] Wading measurement.

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1907 and 1908.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1907.							1907.						
1	4.0	6.8	15.7	6.8	4.9	4.1	16	4.5	12.8	5.7	5.4	4.35	4.0
2	4.0	7.0	15.3	7.5	4.8	4.1	17	4.6	13.2	5.7	5.3	4.35	4.0
3	4.0	7.2	15.0	7.9	4.8	4.1	18	4.6	13.6	5.6	5.3	4.35	4.0
4	4.0	7.4	14.7	7.7	4.7	4.1	19	4.6	13.8	5.6	5.2	4.3	4.0
5	4.0	7.8	14.0	7.4	4.5	4.1	20	4.8	14.1	5.5	5.2	4.3	4.0
6	4.0	8.0	13.0	6.0	4.5	4.1	21	4.8	14.5	5.4	5.2	4.25	4.0
7	4.0	8.4	12.0	5.9	4.5	4.1	22	4.8	14.9	5.3	5.6	4.25	3.95
8	4.1	9.0	11.0	6.0	4.45	4.05	23	5.0	15.0	5.2	5.9	4.2	3.95
9	4.1	9.6	10.0	6.7	4.45	4.05	24	5.2	15.2	5.2	5.9	4.2	3.95
10	4.1	10.0	8.7	6.7	4.4	4.05	25	5.4	15.5	5.1	5.7	4.2	3.9
11	4.2	10.6	6.5	6.2	4.4	4.0	26	5.6	15.7	5.1	5.5	4.15	3.9
12	4.2	11.4	6.0	5.7	4.4	4.0	27	5.8	15.9	5.6	5.2	4.15	3.9
13	4.3	11.8	5.8	5.5	4.4	4.0	28	6.0	16.0	6.0	5.2	4.1	3.9
14	4.4	12.2	5.8	5.5	4.35	4.0	29	6.2	16.0	6.7	5.2	4.1	3.9
15	4.4	12.5	5.7	5.4	4.35	4.0	30	6.4	16.0	6.8	5.1	4.1	3.9
							31	.....	15.8	.....	5.0	4.1	.....

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1907 and 1908. Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	4.7	4.65	4.6	4.7	4.45	4.3	3.95	3.95
2	4.8	4.55	4.65	4.6	4.45	4.25	3.95	3.95
3	4.8	4.5	4.65	4.6	4.4	4.25	3.95	4.0
4	5.0	4.5	4.7	4.6	4.4	4.25	3.95	4.0
5	5.0	4.45	4.75	4.6	4.35	4.25	3.95	4.0
6	5.0	4.45	4.8	4.6	4.35	4.25	3.95	4.0
7	5.1	4.4	4.85	4.55	4.35	4.25	3.9	4.0
8	5.5	4.4	4.9	4.55	4.35	4.25	3.9	4.0
9	6.0	4.4	4.95	4.4	4.35	4.2	3.9	4.0
10	5.5	4.45	4.95	4.4	4.35	4.2	3.9	4.0
11	5.0	4.45	4.95	4.45	4.35	4.2	3.9	3.95
12	5.5	4.5	4.9	4.5	4.35	4.2	3.9	3.95
13	6.5	4.5	4.9	4.5	4.3	4.2	3.9	3.95
14	6.0	4.5	4.85	4.5	4.25	4.2	3.85	3.95
15	5.85	4.45	4.9	4.5	4.25	4.2	3.85	3.95
16	5.75	4.5	4.9	4.45	4.25	4.2	3.85	3.95
17	5.65	4.5	4.9	4.5	4.3	4.1	3.85	3.95
18	5.0	4.45	5.6	4.55	4.3	4.1	3.85	4.0
19	5.4	4.5	5.6	4.55	4.35	4.1	3.85	4.0
20	5.4	4.55	5.6	4.45	4.3	4.1	3.85	4.0
21	5.35	4.55	5.5	4.45	4.3	4.1	3.9	4.0
22	5.25	4.6	5.3	4.4	4.3	4.1	3.9	4.0
23	5.15	4.55	5.3	4.35	4.3	3.95	3.95	3.95
24	5.0	4.6	5.1	4.35	4.3	3.95	3.95	3.95
25	4.95	4.6	5.0	4.35	4.3	4.1	3.95	3.95
26	4.95	4.6	4.9	4.35	4.25	4.1	3.95	3.95
27	4.95	4.65	4.8	4.35	4.25	4.1	4.0	3.95
28	4.85	4.65	4.75	4.4	4.3	4.1	4.0	3.95
29	4.75	4.6	4.75	4.4	4.3	4.1	4.0	.....
30	4.7	4.6	4.7	4.35	4.3	4.1	4.0	.....
31	.....	4.65	.....	4.4	4.35	.....	4.0	.....

NOTE.—The gage heights were affected by ice conditions during 1907–8 about as follows: January 1 to March 31, and during part of November and all of December, 1907; January 1 to March 31, November 14 to 18 and November 29 to December 31, 1908.

Rating table for Mouse River at Minot, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	9.2	5.20	294	6.60	666	9.00	1,038
3.90	20	5.30	321	6.70	687	9.20	1,064
4.00	35	5.40	349	6.80	707	9.40	1,088
4.10	52	5.50	378	6.90	726	9.60	1,112
4.20	70	5.60	407	7.00	744	9.80	1,136
4.30	89	5.70	436	7.20	778	10.00	1,160
4.40	109	5.80	464	7.40	810	11.00	1,280
4.50	130	5.90	492	7.60	841	12.00	1,400
4.60	152	6.00	519	7.80	871	13.00	1,530
4.70	174	6.10	546	8.00	900	14.00	1,700
4.80	196	6.20	572	8.20	928	15.00	1,910
4.90	219	6.30	597	8.40	956	16.00	2,190
5.00	243	6.40	621	8.60	984		
5.10	268	6.50	644	8.80	1,012		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1903 to 1908 and is well defined.

Monthly discharge of Mouse River at Minot, N. Dak., for 1907 and 1908.

[Drainage area, 8,400 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	621	35	183	0.022	0.02	10,900	A.
May	2,190	707	1,500	.179	.21	92,200	A.
June	2,100	568	820	.098	.11	48,800	A.
July	885	243	470	.056	.06	28,900	A.
August	219	52	104	.012	.01	6,400	A.
September	52	20	36.2	.0043	.005	2,150	A.
October			20	.0024	.003	1,230	D.
November			16	.0019	.002	952	D.
December			11	.0013	.001	676	D.
The period						192,000	
1908.							
January			8	.00095	.001	492	
February			6	.00071	.0008	345	
March			20	.0024	.003	1,230	
April	644	174	311	.037	.04	18,500	A.
May	163	109	136	.016	.02	8,360	A.
June	407	152	239	.028	.03	14,200	A.
July	174	99	125	.015	.02	7,690	A.
August	120	80	94.1	.011	.01	5,790	A.
September	89	28	63.0	.0075	.008	3,750	B.
October	35	15	23.1	.0028	.003	1,420	C.
November	35		30	.0036	.004	1,790	C.
December			15	.0018	.002	922	D.
The year	644		89.2	.011	.14	64,500	

NOTE.—Discharge has been estimated for period October 1, 1907, to March 31, 1908, and is very approximate, there being only one measurement during the period. Discharge for November 29 to December 31, 1908, has been estimated and is only fair. No accuracy values given for January to March; values are only roughly approximate.

EVAPORATION AT UNIVERSITY, N. DAK.

The evaporation gage at University, N. Dak., was established April 17, 1905. Daily observations have been made through the whole of the open seasons of 1905 to 1908, except the first few days of each season before the streams were entirely clear of floating ice cakes, which would interfere with the gage. It is located on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, which is immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

The coulée drains about 60 square miles of very level prairie. Occasionally, for a few days or hours during the spring thaws, it carries a very large flow. For example, on April 3, 1904, it reached a measured maximum of approximately 1,500 second-feet. Except for such brief freshets, however, the flow is small, varying from 1 second-foot or less to 10 or 20 second-feet. In very dry weather for several weeks at a time there may be merely a succession of pools with no perceptible flow.

The gage is placed on the largest of these pools, which at extreme low stage has a central depth of 6 feet and an area of at least 30 square

rods. It is unshaded and there are no large trees in the vicinity. The water surface is ordinarily about 15 feet below the level of the surrounding open prairie, but the banks of the ravine slope so gently (from a top width of 10 or 20 rods or more) that the wind has nearly its normal effect at the gage.

A heavy galvanized-iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

A standard rain gage is located on the open prairie about 10 rods distant. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the total evaporation for the day.

It has been found that the arrangement of this tank is such that the temperature of the water in the tank is always nearly identical with that of the water outside, the difference usually being imperceptible and rarely more than a degree. The temperature of the water and the air have been observed daily, at the same hour as the observation of evaporation, which was regularly between 6 and 7 p. m., and the amount of rainfall in the preceding 24 hours (if any) was recorded at the same time.

The evaporation shows great variation from day to day, between a minimum of zero in cold, damp weather, and an ordinary maximum of 0.20 inch to 0.30 inch per day in hot, dry, windy weather. These daily variations can not be satisfactorily discussed without detailed comparison with complete records of wind velocity, cloudiness, and humidity, of which reliable regular observations were not continuously made. The records are therefore arranged in the most convenient form for reference or study, if summarized in ten-day periods.

In the following tables for each ten-day period (one-third of a month) the facts shown are, first, the total evaporation; second, the total rainfall; third, the approximate mean temperature of the water; fourth, the mean observed air temperature. In the years of 1905 and 1906, the air temperatures are not the mean temperatures for the whole day, but merely the temperatures at the hour of observation (usually 6 or 7 p. m.), and are not entirely consistent, since the hour of observation varied slightly; but the increase of evaporation with rise of temperature is clearly shown. The air temperatures as given for the year 1907 are of more value, being the averages of the maximum and minimum thermometer readings for each day.

Evaporation, rainfall, and temperature at University, N. Dak.

Date.	Evaporation.	Rainfall.	Temperature of—	
			Water.	Air.
1905.	*Inches.*	*Inches.*	° *F.*	° *F.*
April 17 to 20	0.35	0.00	32	46
April 21 to 30	1.43	.20	40	56
May 1 to 10	.67	2.57	42	47
May 11 to 20	1.01	.73	48	60
May 21 to 31	1.80	.05	53	65
June 1 to 10	1.41	1.83	56	68
June 11 to 20	1.27	1.39	59	62
June 21 to 30	1.21	.83	59	65
July 1 to 10	1.64	.01	68	71
July 11 to 20	2.03	2.31	73	74
July 21 to 31	1.79	3.16	69	69
August 1 to 10	1.29	.72	71	75
August 11 to 20	1.37	2.55	66	71
August 21 to 31	1.36	1.27	69	73
September 1 to 10	1.11	.27	61	66
September 11 to 20	1.05	.66	60	61
September 21 to 30	1.59	.69	61	66
October 1 to 10	1.08	.01	53	58
October 11 to 13	.29	.00	44	48
Total, April 17 to October 13	23.75	19.25	.....	.....
1906.				
April 1 to 10	.80	.35	43	49
April 11 to 20	1.32	1.44	52	52
April 21 to 30	1.40	.30	60	60
May 1 to 10	1.01	.49	55	51
May 11 to 20	1.31	1.40	60	61
May 21 to 31	1.36	1.17	57	57
June 1 to 10	1.16	.97	67	68
June 11 to 20	1.65	1.39	72	70
June 21 to 30	1.32	.73	68	64
July 1 to 10	1.50	.20	74	71
July 11 to 20	1.42	1.59	72	67
July 21 to 31	1.91	.77	73	72
August 1 to 10	1.36	.15	73	72
August 11 to 20	2.02	.30	79	76
August 21 to 31	1.54	.64	68	63
September 1 to 10	1.91	.34	75	75
September 11 to 20	1.04	1.07	65	62
September 21 to 30	1.09	.20	61	66
October 1 to 10	.98	.06	52	52
October 11 to 20	.61	.52	51	54
October 21 to 30	.33	.00	39	40
Total, April 1 to October 30	27.04	14.08	.....	.....
1907.				
April 22 to 30	.46	.05	39	34
May 1 to 10	.83	.11	43	33
May 11 to 20	1.16	.45	48	45
May 21 to 31	1.49	.07	51	53
June 1 to 10	1.43	2.32	51	57
June 11 to 20	1.51	.81	69	65
June 21 to 30	1.61	1.50	76	66
July 1 to 10	1.95	.49	79	67
July 11 to 20	2.05	1.47	79	67
July 21 to 31	1.99	.95	79	65
August 1 to 10	1.36	.52	74	67
August 11 to 20	[a] 1.63	.21	72	66
August 21 to 31	[a] 1.54	1.14	70	63
September 1 to 10	[a] 1.12	.53	66	58
September 11 to 20	1.04	2.58	64	56
September 21 to 30	1.01	.75	.....	44
October 1 to 10	.83	.42	.....	51
October 11 to 20	.58	.00	.....	41
October 21 to 31	.57	.22	.....	39
November 1 to 10	.17	.05	.....	36
Total, April 22 to November 10	24.33	14.64	.....	.....

[a] Subject to possible small errors, on account of occasional malicious disturbance of gage, requiring estimates of evaporation on a few days.

Evaporation, rainfall, and temperature at University, N. Dak.—Continued.

Date.	Evaporation.	Rainfall.	Temperature of—	
			Water.	Air.
1908.	*Inches.*	*Inches.*	*F.*	*F.*
April 15 to 20	.77	.30	35	48
April 21 to 30	1.49	.38	43	47
May 1 to 10	1.65	.00	53	45
May 11 to 20	1.32	3.32	51	55
May 21 to 31	.86	.45	56	54
June 1 to 10	.79	.40	61	63
June 11 to 20	.74	1.60	65	65
June 21 to 30	1.69	.70	71	69
July 1 to 10	2.21	.02	75	67
July 11 to 20	1.99	1.00	77	68
July 21 to 30	2.12	1.45	76	72
August 1 to 10	2.22	.00	71	68
August 11 to 20	1.89	.00	69	62
August 21 to 31	1.66	2.41	65	64
September 1 to 10	1.70	.00	68	65
September 11 to 20	1.47	.00	68	70
September 21 to 30	1.07	.50	39	50
October 1 to 10	.67	.15	47	51
October 11 to 20	.62	.21	44	51
October 21 to 31	.29	.26	35	35
November 1 to 10	.19	.01	32	35
Total, April 15 to November 10	27.41	13.16		

To summarize in the briefest form for the four years 1905 to 1908: During the warm seasons of 180 days, 213 days, 203 days, and 210 days the total evaporations were 23.75 inches, 27.04 inches, 24.33 inches, and 27.41 inches respectively; expressed in daily averages, these figures are equivalent to means of 0.132 inch, 0.127 inch, 0.120 inch and 0.131 inch per day for the four seasons, the smaller average for 1907 resulting from the fact that that year was colder than the normal.

During nearly all the remainder of each year water surfaces were frozen, and it was not convenient to make reliable evaporation observations. There is a very considerable evaporation from ice surfaces, and if—including the many days when the ice surface is thawing and being rapidly dissipated in vapor, and the few days of the open season before observations were begun—the mean evaporation for this period be estimated as between 0.030 and 0.070 inch per day, the total evaporation during the time not observed would be between 5 and 11 inches, making the total annual evaporation between 30 and 36 inches.

The latitude of this place is 48°, its elevation above sea level 820 feet, and its normal rainfall about 20 inches a year.

The conditions at the gage are such that the results may be considered as fairly representative of those to be obtained at any stream or reservoir in the region.

UPPER MISSISSIPPI RIVER DRAINAGE.

GENERAL DESCRIPTION.

Mississippi River drains the greater part of the territory of the United States lying between the Allegheny and the Rocky Mountains. Its basin, irregular in shape, occupying the central part of the United States, is best described as an oblong, with the major axis, 1,700 miles in length, running southeastward from the northwestern part of Montana, through North Dakota, Nebraska, Missouri, and Tennessee, into the northwestern corner of Alabama. On each side of this line the basin spreads out from 300 to 500 miles, while on the east is a large proturberance from the general outline extending to the Alleghenies. The basin comprises about 1,240,000 square miles, and includes wholly or in part 30 States, besides a small area in the Dominion of Canada. Of the total area, about 527,000 square miles drain to the Missouri, about 171,500 square miles to the upper Mississippi above the mouth of the Missouri, and about 204,000 square miles to the Ohio. The mean annual flow of the Missouri is about 100,000 second-feet; of the upper Mississippi, about 125,000 second-feet; of the Ohio, about 300,000 second-feet.

Immediately beneath the covering of drift at the sources of the Mississippi lie the oldest rocks known to the geologist. Its mouth is surrounded by the soft marshes of its own delta now forming. Between these two extremes rocks of all geologic ages are represented.

All varieties of topography are likewise exhibited in the drainage basin, mountain and prairie, arid plain, and alluvial bottom covered with vegetation being fully represented; but the greater part of its broad extent is very uniform in contour.

For convenience in publication the basin of the Mississippi River has been divided into upper Mississippi, Missouri River, lower Mississippi, and Ohio drainage basins. The upper Mississippi basin, as considered in this discussion, is that portion lying above the mouth of the Missouri. The upper Mississippi basin therefore occupies the north-central part of the United States, including Minnesota, Wisconsin, Iowa, Illinois, Indiana, Missouri, and a few square miles in South Dakota and the northern peninsula of Michigan. The sources of this branch of the great river are almost exactly in the center of the continent on an east and west line.

The Mississippi rises, not in Lake Itasca, so long considered the source, but in a smaller lake which drains into Lake Itasca, called Hernando de Soto, situated in the northeastern part of Becker County, Minn. From these lakes to the mouth of Crow Wing River it flows almost in a circle, as at this point it is only 75 miles from its sources, while the distance following the river is about 450 miles. Leaving the lakes its course is northward, but below the junction with the

Crow Wing it turns to the south and continues in this direction until it finally reaches the Gulf of Mexico.

The total length of the river is about 2,555 miles; from the source to the mouth of the Ohio is about 1,500 miles.[a]

The important tributaries of the upper Mississippi beginning at the source and following down the west bank are: Leech Lake, Willow, Pine, Crow Wing, Sauk, Minnesota, Cannon, Turkey, Wapsipinicon, Iowa, Des Moines, and Missouri rivers. On the east bank are: Prairie, Elk, Rum, St. Croix, Chippewa, Black, La Crosse, Wisconsin, Rock, Illinois, Kaskaskia, Big Muddy, and Ohio rivers.

From Lake Hernando de Soto to the Falls of St. Anthony the river flows almost exclusively through a drift-covered region. Down to Pokegama Falls it occupies a valley which is in some places narrow, in others broad and savanna-like, with many rapids in the narrower and with gentle or sluggish currents in the broader portions. In this part of its course it drains a number of lakes, among which Bemidji, Cass, Winnibigoshish, and Leech are the most important. The total fall from the head of the stream to the mouth of Leech Lake River, which is nearly as large as the main stream, is about 420 feet. The first rock in place is at Pokegama Falls, and thence to the mouth of Crow Wing River, which enters from the west, the average width of the stream is 300 feet, the valley is less winding, and the current is good, with many rapids of small extent.

Below the mouth of the Crow Wing the river flows in a general southeasterly direction for about 475 miles. Within this stretch are several rapids—the chief being Little Falls and Sauk Rapids—and many timbered islands. The banks are abrupt, of clay or sandy loam, and lead to meadows that stand 60 feet above the river. At the falls of St. Anthony the river pitches down a vertical fall and rapids amounting to 75 feet in half a mile, and in so doing leaves the prairie and clay banks for a channel that lies between rocky bluffs of limestone and sandstone, which continue for many miles down the river, gradually increasing to a height of 500 feet as the bed sinks below the general prairie level. The sides of the bluffs are not vertical, bare surfaces of rock, but are composed of easily eroded stone and drift, which form well-wooded or grassy slopes.

Minnesota River, formerly called St. Peters River, enters the Mississippi about 10 miles below St. Anthony Falls, and below its mouth the breadth of the main stream averages 1,000 feet. From this point to the mouth of the Missouri it is a broad, placid stream with innumerable islands, the entire width of the valley averaging 1 mile. In many

[a] The Twenty-Second Annual Report of the United States Geological Survey, Pt. IV, p. 210, contains a detailed description of the Mississippi from the sources to St. Paul, taken from the Reports of the Chief of Engineers, U. S. Army. The hydrographic investigations of the United States Engineer Corps on the upper Mississippi extend over a period of thirty-two years, from 1866 to 1898, and form, according to the Report of the Chief of Engineers for 1897, "the largest continuous record over large drainage areas that has been made in the United States."

places, especially where tributaries enter, fertile flats lie between the river and the bluffs. Fifty-five miles below the mouth of the Minnesota is Lake Pepin, an expansion of the river apparently caused by the immense quantities of sand brought down by the Chippewa. At two places exceptions occur to the otherwise placid character of the river. At Rock Island, Ill., 384 miles from St. Paul, there are rapids by which the river falls 20.4 feet in 12 miles; and at Keokuk, Iowa, 509 miles from St. Paul, is the foot of the Des Moines Rapids, where in a distance of 11 miles the river falls 21.85 feet.

The elevation of the sources of the river is approximately 2,000 feet; at St. Paul, Minn., the elevation is 690 feet; at Clinton, Iowa, 570; at St. Louis, Mo., 385; at Cairo, Ill., the elevation is 275 feet.

The headwaters of the main stream and its tributaries which lie in Wisconsin and Minnesota may be said to be in a forested area; that part of the drainage basin outside of Minnesota and Wisconsin is deforested; a great portion consists of prairie land.

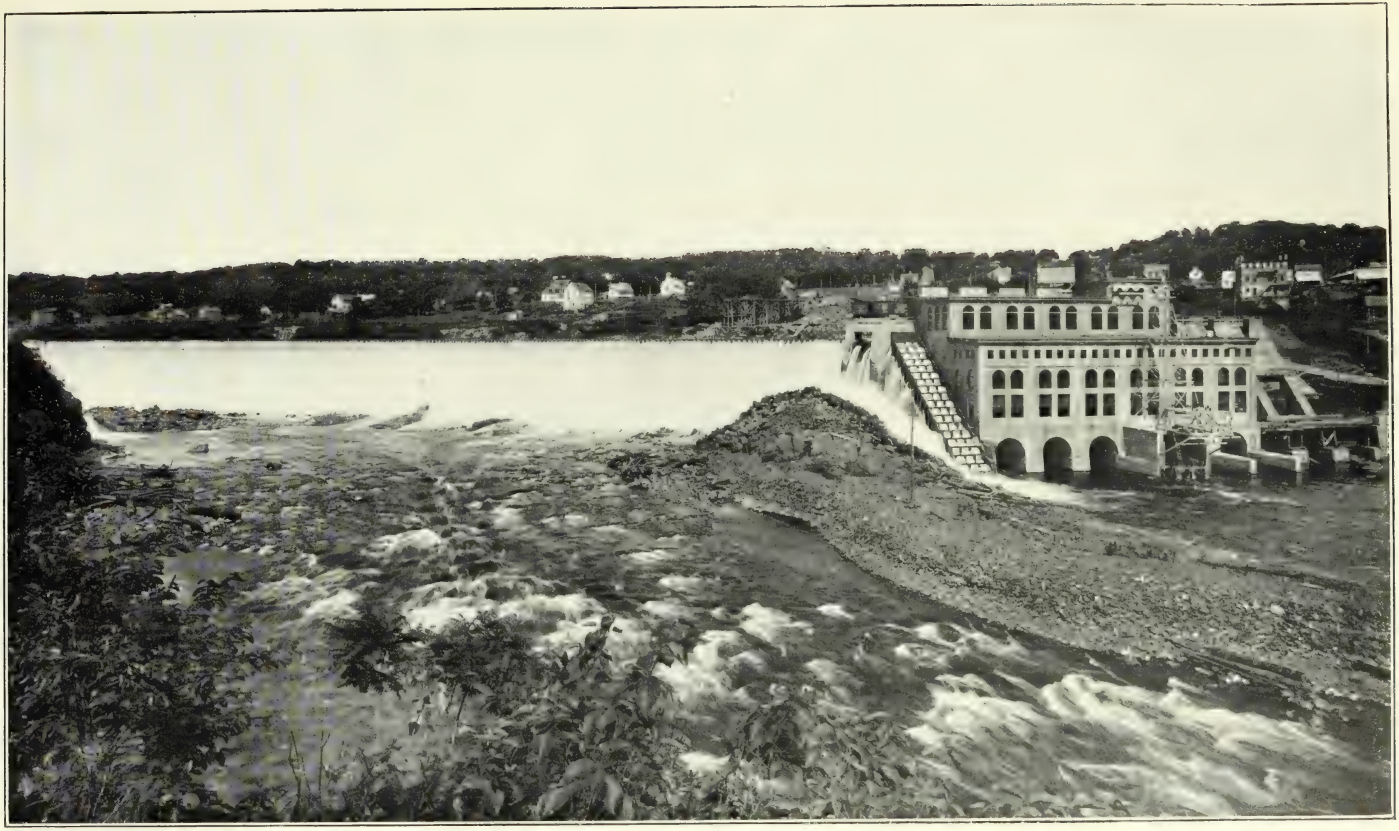
The mean annual rainfall in the upper Mississippi basin is about 30 inches, ranging from 35 inches at the northern boundary to about 40 inches in the southern part of the basin. The winter conditions in Wisconsin, Minnesota, and Iowa are severe, snowfall is heavy and lasts for considerable periods, ice forms to a thickness of 1 to 2 feet, and lasts for three to four months. In other parts of the drainage basin the winters are milder.

According to some authorities, the basin of the upper Mississippi contains from 5,000 to 6,000 lakes, nearly all of which are near the sources of the main river and its northern tributaries, and which, with the numerous swamps, produce a natural storage steadying the flow of the river. By building dams of ordinary height it is possible to create large reservoirs at many of these lakes. The Army Engineer Corps has built and is successfully operating a few reservoirs at the headwaters of the Mississippi River as an aid to navigation.

The basin affords numerous opportunities for water-power development, especially on those tributaries in the States of Wisconsin and Minnesota. (See Pls. III, *B*, IV, and V.) There are valuable power sites on the main stream, the more important of which are utilized or about to be.

The following gaging stations have been maintained on the Mississippi River and the minor tributaries. Those on the principal tributaries are given elsewhere.

Mississippi River near Sauk Rapids, Minn., 1903–1906.
Mississippi River at Anoka, Minn., 1905–1908.
Mississippi River at St. Paul, Minn., 1895–1901.
Crow Wing River at Pillager, Minn., 1903.
Minnesota River near Mankato, Minn., 1903–1906.
Crow River near Dayton, Minn., 1906.
Maquoketa River at Manchester, Iowa, 1903.



DAM AND POWER HOUSE AT ST. CROIX FALLS, WIS.

MISSISSIPPI RIVER AT ANOKA, MINN.

This station, which is located at the highway bridge in the southwestern part of Anoka, Minn., was established May 8, 1905, to obtain data for use in studying water power, water supply, pollution, flood control, storage, and navigation problems.

The drainage area above the section is about 17,300 square miles. Rum River enters on the left bank about one-half mile below the station.

Winter conditions are severe at this station. Ice forms to a thickness of about 2 feet and lasts from three to four months, but the section is generally open at one or two places during the ice period. Logging operations, for which the river is extensively used, may affect the gage readings to a small extent. Portions of the river bed are occasionally covered with sunken logs, but these probably have little or no effect on the gage heights.

The gage reader at this station has been paid by the Great Northern Development Company of Duluth, Minn., since August, 1906.

The gage was originally established in 1896 by the army engineers. The datum of the gage has remained unchanged.

No measurements have been taken at this station since 1906.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1907 and 1908.

[Ross Cutler and Bernard Witte, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1		7.4	2.7	3.9	2.3	0.9	1.1	1.4	0.9	0.8
2		7.0	2.7	3.8	2.1	.8	1.0	1.4	.9	.8
3		7.5	2.6	3.6	1.9	.6	.9	1.4	.9	
4		6.8	2.6	3.5	1.7	.6	.8	1.4	.9	
5		6.2	2.5	3.4	1.6	.6	.7	1.4	1.0	
6		6.0	2.4	3.3	1.6	.6	.6	1.3	1.1	
7		5.8	2.4	3.0	1.7	.8	.5	1.2	1.0	
8		5.6	2.2	2.8	1.4	.9	.4	1.2	1.0	
9		5.5	2.2	2.7	1.3	1.0	.4	1.2	1.0	
10		5.2	2.1	2.8	1.2	.9	.3	1.2	.9	
11		5.0	2.1	3.0	1.0	.8	.3	1.1	1.0	
12		4.9	1.7	3.7	.9	.6	.4	1.0	1.1	
13		4.7	1.5	4.1	.8	.8	.3	.9	1.2	
14		4.5	1.6	4.3	.9	.8	.3	.8	1.0	
15		4.3	1.7	4.5	1.0	.8	.4	1.2	.9	
16		4.1	1.8	4.6	1.0	1.0	.5	1.0	.8	
17		4.0	1.7	4.4	1.2	.9	.6	.9	.7	
18		3.8	1.8	4.2	1.2	.8	.6	.9	.8	
19		3.7	1.8	4.0	1.1	.6	.7	.9	.9	
20		3.6	1.6	3.8	1.0	1.2	.9	.9	.8	
21		3.5	1.7	3.6	.9	1.9	1.3	.9	.8	
22		3.4	1.8	3.4	.6	1.8	1.5	.9	.8	
23		3.3	1.6	3.4	1.1	1.6	1.9	.9	.8	
24		3.3	1.5	3.2	1.5	1.5	1.8	.8	.8	
25		3.0	1.6	3.0	.8	1.5	1.8	.7	.8	
26	4.9	3.0	1.9	3.0	.7	1.4	1.7	.8	.8	
27	4.7	2.9	2.2	2.8	.7	1.4	1.6	.6	.7	
28	5.1	2.8	2.7	2.6	.7	1.4	1.7	.5	.7	
29	5.8	2.7	3.3	2.6	.7	1.4	1.7	.7	.7	
30	6.5	2.7	3.7	2.4	.7	1.3	1.6	.9	.7	
31	7.5		4.0		1.0	1.3		.7		

[a] Ice conditions January 1 to March 25 and December 3 to 31, 1907.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]										
1		1.7	2.6	5.4	4.9	1.4	.7	1.0	.8	.1
2		1.7	2.6	5.7	4.7	1.4	.6	.9	.7	.2
3		1.7	2.4	5.9	4.5	1.3	.6	1.0	.7	.8
4		1.6	2.2	5.8	4.2	1.3	.6	.8	.6	.8
5		1.6	2.1	5.6	4.0	1.3	.6	.6	.7	.6
6		1.6	2.1	5.5	3.8	1.3	.7	1.0	.6	
7		1.6	1.9	5.5	3.6	1.2	.7	.8	.6	
8		1.7	1.8	5.5	3.4	1.2	.6	.6	.6	
9		1.7	1.7	6.0	3.2	1.2	.6	.6	.4	
10		1.6	1.6	6.5	2.9	1.0	.6	.6	.4	
11		1.6	1.5	7.0	2.7	1.1	.5	.5	.4	
12		1.6	1.5	7.8	2.5	1.0	.5	.5	.6	
13		1.6	1.5	7.6	2.3	1.0	.6	.7	.4	
14		1.5	1.6	7.2	2.1	.9	.6	.6	.4	
15		1.4	1.7	6.8	2.0	.8	.4	.6	.4	
16		1.4	1.8	6.4	2.0	.8	.7	.6	.4	
17		1.2	1.8	6.0	1.9	.7	.8	.4	.4	
18		1.2	1.9	5.7	1.8	.7	.9	.4	.4	
19		1.1	1.9	5.4	1.8	1.0	1.0	.4	.3	
20		.9	2.0	5.0	1.8	.9	.8	.4	.3	
21		1.1	2.0	4.9	1.7	.8	.8	.4	.4	
22		1.0	2.0	4.9	1.7	.8	1.0	.5	.3	
23		.9	2.1	5.0	1.7	.7	.5	.5	.3	
24		1.0	2.4	5.0	1.6	.7	.6	.6	.3	
25		1.2	2.8	5.0	1.6	.9	.6	.7	.2	
26		1.4	3.2	5.1	1.6	1.1	.6	.8	.2	
27		1.6	3.6	5.1	1.6	1.1	.5	.8	.3	
28		1.9	4.0	5.1	1.6	1.1	.6	.8	.2	
29		2.2	4.4	5.1	1.6	1.0	.9	1.0	.2	
30	1.8	2.4	4.8	5.1	1.5	.8	1.0	.9	.2	
31	1.8		5.2		1.5	.7		.8		

[a] Ice conditions January 1 to March 28 and November 30 to December 31, 1908.

CHIPPEWA RIVER DRAINAGE BASIN.

DESCRIPTION.

Chippewa River drainage system has its sources in more than a hundred lakes, large and small, with many connecting swamps, lying in the northwestern part of the State of Wisconsin, near the Michigan boundary and only 20 miles from Lake Superior. The main line of drainage runs very nearly along the central line of the basin, but the name of Chippewa River is not applied to the continuation of the main stream. The river divides 112 miles from the mouth. One branch, the prolongation of the line of drainage, called the Flambeau, rises in the lakes near the Michigan line, at an elevation of a little over 1,600 feet above sea level; the other branch, the Chippewa, is formed in the central part of Sawyer County, by the union of East and West branches, both of which rise in the southwestern part of Ashland County. The course of the river is general southwestward to its junction with the Mississippi at the foot of Lake Pepin. The Flambeau drains about 1,983 square miles, while the Chippewa above its junction with the Flambeau drains only about 1,777 square miles.

The important tributaries of the Chippewa are as follows: From the west, beginning at the sources, West Branch and Red Cedar

rivers; from the east are East Branch, Thornapple, Flambeau, Jump, Yellow, and Eau Claire rivers.

The total length of the Chippewa is 267 miles. The total drainage area is about 9,573 square miles, of which over 6,000 square miles include the most unsettled region of northern Wisconsin.

The drainage basin is regular in outline and shape, being about 180 miles long and about 60 miles in average width. The entire area above Chippewa Falls is covered with glacial drift, and the underlying crystalline rocks appear only in the river bed. In the southern part of the bed the rivers have eroded deeply into the drift and rock, but in the northern districts they have not cut much below the surface. The country is level or rolling.

With but few exceptions all the many and important water powers on Chippewa River are found in the region of crystalline rocks, but on account of the deep glacial drift the powers on the upper streams occur as bowlder rapids.

The lakes in this drainage basin are situated in two widely separated groups; one in the extreme northeastern part at the headwaters of the Flambeau, the other in the northwestern part at the headwaters of Chippewa and Red Cedar rivers. The remainder of the area is almost devoid of lakes. The wooded regions, however, include very large areas of cedar and tamarack swamps. The sources of Chippewa River have an elevation of about 1,500 feet above sea level; at Chippewa Falls it is 806 feet; and at the mouth of the river the elevation is about 665 feet. The elevation of the sources of Flambeau River is about 1,650 feet; at Ladysmith the elevation is 1,115 feet.

This drainage basin contains the richest forests of both hard and soft woods. Although lumbering has been carried on actively for many years, considerable pine timber still remains, chiefly at the upper headwaters, but it is fast disappearing. The upper half of the drainage basin may be considered forested area.

The mean annual rainfall is about 30 inches. The winters are severe. The snowfall is heavy and lasts for long periods; ice forms on the streams about 2 feet in thickness and remains for three to four months.

This drainage area affords an unusual number of excellent sites for reservoirs. According to surveys made by the United States Engineer Corps in 1880, twelve reservoir sites were located and surveyed, whose total capacity was approximately 25 billion cubic feet. The highest dam necessary was about 26 feet. The operation of these reservoirs, it was estimated, would increase the ordinary low-water flow of the river by 3,245 second-feet for ninety days, thus about doubling the present available water power of the river. The main obstacle to building such reservoirs at the present time by the Government is the fact that, owing to the settling of this region, the land that would be flooded has become very valuable. Private enterprise has developed some of the smaller of these reservoirs.

Several valuable developed water powers and numerous undeveloped power sites are located on this river and its tributaries. The Dells Paper and Pulp Company's plant near Eau Claire has a turbine installation of over 8,000 horsepower, and plans have been made to increase the head from 26 to 32 feet by increasing the height of the dam. On the Flambeau and Red Cedar exceptionally good power sites exist. Near Ladysmith, on the Flambeau, are two developments, one of which has a rated turbine installation of 3,000 horsepower. In a 30-mile stretch of Red Cedar River there are six sites for water power capable of developing about 13,000 horsepower. On account of the numerous lakes in the drainage basin of the Chippewa, with the possibility of using them for storage, this river system is destined to become a great center of power, but the development of the numerous power sites is retarded by the fact that at the present time the section is not thickly settled and railroad facilities are lacking in many portions.

The river and its tributaries are used extensively for running logs, but in the areas where there are railroads, the logs are moved by rail, as it has been found that the rivers can not compete with railroad transportation for log running. The extension of railroad facilities in this section will tend to relieve the river of its burden of logs and correspondingly add to the value of the river for water power.

The use of the river for flooding logs modifies the normal flow of the river very materially.

The following gaging stations have been maintained in this drainage basin:

Chippewa River at Chippewa Falls, Wis., 1899–1908.
Chippewa River near Eau Claire, Wis., 1902–1908.
Flambeau River near Ladysmith, Wis., 1903–1906.
Red Cedar River at Menominee, Wis., 1907–1908.

FLAMBEAU RIVER SURVEY.

In order to point out the power possibilities along Flambeau River, a survey was made during 1906 from Flambeau to a point near the western border of Lac Du Flambeau Indian Reservation; the section from the mouth to Flambeau had been surveyed by the Geological Survey in 1902. From the data collected sheets have been prepared showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets, and may be had on application to the Director of the Geological Survey.

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

This station is located at the highway bridge at Chippewa Falls, Wis. The gage was originally established by the Chippewa Lumber and Boom Company, in April, 1899, and records of gage heights since that time have been obtained by that company. The gage heights

as originally recorded are in feet and inches, but have been reduced to feet and hundredths. On June 1, 1906, the United States Geological Survey began taking discharge measurements at this place to determine the amount of water available for water power and storage, and to obtain data of value in general statistical and comparative studies of run-off. The United States Weather Bureau has obtained gage-height records for this station beginning with 1904, and the gage heights as furnished by them have been used for March to September, 1905, 1907, and 1908.

The dam of the Chippewa Lumber and Boom Company is about 2,500 feet above the station.

The winters are severe in this vicinity, and ice forms on the river about 2 feet in thickness; but considerable open water is found at the measuring section, owing to the swift water and the proximity of the dam. The river fluctuates very rapidly at times during the "sawing season" on account of the storage and release of water at a reservoir at Holcombe, some 30 miles above. The stored water is used to flood logs to the sawmill.

The normal flow of the stream is much modified by logging and the power plants at Chippewa Falls, which cause great and rapid fluctuations in stage from day to day. The datum of the gage has remained unchanged.

Conditions of flow appear to be permanent, and an excellent rating curve has been developed. (See fig. 1.)

Information in regard to this station prior to 1908 is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Chippewa River at Chippewa Falls, Wis., 1906 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 1	Murphy and Brennan	721	4,700	[a] 6.70	18,000
1907.					
April 2	A. H. Horton	724	5,620	7.88	25,200
May 6	do	656	2,710	3.69	9,210
June 19	G. A. Gray	565	1,790	2.40	5,090
July 17	do	481	1,320	1.35	3,070
August 21	do	479	1,130	1.00	2,030
September 21	do	755	7,190	9.95	32,000
September 23	do	728	5,700	7.90	23,200
September 24	do	698	4,950	6.90	19,600
September 25	do	662	3,280	4.47	12,600
September 26	do	660	3,530	4.90	12,500
October 19	do	487	1,320	1.35	2,940
November 15	do	413	1,010	1.40	2,790
December 20 [b]	do	432	992	.80	1,540
1908.					
January 23 [b]	G. A. Gray	470	708	.80	1,380
February 14 [b]	do	487	825	1.20	1,720
April 30	do	741	5,840	7.90	24,500
May 1	do	716	5,220	7.15	21,500
May 2	do	699	4,510	6.20	17,300
September 12	do	426	969	.80	1,550

[a] Rapid change of stage during measurement. [b] Ice conditions.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899.[a]										
1			7.33	2.50	5.71	1.58	1.17	.....	2.67	1.17
2			7.50	3.33	1.00	6.50	1.00	0.92	2.67	1.25
3			7.50	5.75	1.67	1.00	1.00	.83	2.25	.....
4			7.75	3.50	1.83	1.25	1.00	.83	1.33	1.17
5			6.75	4.08	2.00	1.50	1.17	.83	.....	1.00
6			8.75	4.83	2.25	.75	1.17	1.00	1.33	1.00
7		1.00	5.67	4.83	2.17	1.50	1.17	.83	1.25	.....
8		1.42	4.50	4.75	4.79	1.50	1.17	.50	1.25	.....
9		2.50	4.25	5.67	—.50	1.50	1.25	.75	1.83	.....
10		2.67	3.50	6.50	1.50	1.50	1.33	.75	1.83	.....
11		3.17	3.33	3.00	1.83	1.50	1.67	.83	1.75	1.50
12		3.29	4.00	2.50	1.83	1.33	1.75	.83	.....	.....
13		4.17	6.12	4.83	4.16	1.00	1.67	.92	1.83	.....
14		6.25	1.83	5.50	.....	1.00	1.67	.92	1.67	.....
15		6.00	2.00	7.00	.....	1.50	1.33	.....	1.50	.....
16		6.33	2.75	6.67	1.00	1.00	4.25	..92	1.67	.....
17		6.33	4.50	5.75	1.33	1.00	.....	1.00	1.50	.....
18		5.25	6.25	4.12	.33	1.00	1.00	2.00	1.50	.....
19		5.00	6.50	3.75	.33	6.12	1.25	5.48	.....	.....
20		5.00	8.38	4.75	1.08	1.50	1.25	2.42	1.58	.....
21		5.25	4.00	4.00	1.42	1.50	1.00	2.33	1.58	.....
22		5.25	4.33	4.00	1.42	1.25	1.00	.....	1.58	.....
23		4.83	3.83	3.67	1.42	1.33	1.00	1.58	1.50	.....
24		4.50	3.25	6.54	1.58	1.17	.....	1.83	1.50	.....
25		4.00	3.25	1.83	2.00	1.17	1.17	2.83	1.83	.....
26		3.75	3.00	1.83	2.00	1.00	1.08	4.83	.....	.....
27		2.34	5.58	2.00	1.83	1.00	1.00	5.00	1.58	.....
28		4.00	3.50	2.25	1.83	1.33	1.00	7.12	1.50	.....
29		8.50	4.00	2.30	1.17	1.17	1.08	.....	1.50	.....
30		4.83	3.50	2.58	.....	1.17	1.08	3.25	.....	.....
31		.....	3.75	.....	1.58	1.17	.....	3.17	.....	.....
1900.[b]										
1		.....	3.33	1.33	.....	2.17	7.00	4.50	6.66	.....
2		.....	3.83	1.33	1.08	2.00	.....	4.33	9.21	.....
3		.....	3.33	.....	1.33	2.00	3.17	4.75	9.75	.....
4		.....	3.42	1.33	2.08	4.92	6.00	10.83	9.00	.....
5		.....	5.17	1.33	2.42	.....	5.00	13.17	7.50	.....
6		.....	3.33	1.33	3.58	1.67	.....	13.17	6.50	.....
7		3.08	3.25	1.33	4.83	1.50	4.00	.....	5.50	.....
8		3.83	2.25	2.00	6.96	1.50	7.66	10.67	5.00	.....
9		4.17	2.07	4.29	3.17	1.50	2.50	9.33	3.83	.....
10		5.75	2.67	1.25	2.67	2.00	3.25	8.17	4.00	.....
11		5.25	3.17	1.25	3.00	5.50	4.79	6.83	.....	.....
12		4.50	6.25	1.00	2.75	6.00	11.42	6.17	3.25	.....
13		3.67	2.42	1.00	2.50	6.17	13.00	5.50	3.25	.....
14		3.58	2.92	1.00	7.75	5.50	12.00	3.75	3.00	.....
15		2.50	2.83	1.00	2.00	4.83	10.60	4.50	2.75	.....
16		2.17	2.58	1.00	2.25	4.17	8.00	4.08	2.50	.....
17		3.25	2.17	1.00	2.25	3.88	7.00	3.75	2.25	.....
18		8.69	2.17	1.00	2.17	6.20	4.83	7.21	.....	.....
19		11.86	4.88	1.00	3.00	2.00	4.75	2.33	2.25	.....
20		11.96	1.67	1.00	2.83	3.17	4.33	2.17	2.25	.....
21		10.83	1.67	.92	6.58	3.50	5.00	.....	2.25	.....
22		9.17	2.17	1.17	.....	4.58	5.58	2.17	2.25	.....
23		7.50	2.00	1.00	2.25	5.00	5.50	2.00	2.25	.....
24		6.83	1.83	1.00	2.00	6.42	5.25	2.17	2.25	.....
25		5.75	1.50	.83	2.17	9.38	5.67	4.00	.....	.....
26		5.50	4.16	.83	2.00	4.83	6.67	2.67	.....	.....
27		4.83	1.67	.75	2.00	4.83	6.67	2.17	.....	.....
28		3.83	1.42	1.25	4.42	3.50	6.25	.....	.....	.....
29		3.67	1.50	1.42	.....	3.25	5.50	2.67	.....	.....
30		3.33	1.25	1.00	1.50	2.75	4.83	3.75	.....	.....
31		.....	1.33	.....	1.75	2.50	.....	4.33	.....	.....

[a] Ice conditions January 1 to April 9 and about December 1 to 31, 1899.
[b] Ice conditions January 1 to April 7 and probably November 25 to December 31, 1900.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.[a]										
1		3.00	4.00	1.50	3.58	3.25	1.00	3.25	1.50	
2		3.50	4.00	1.17	3.00	2.75	1.00	2.92	2.34	
3		4.00	4.00	1.17	3.17	5.08	1.00	3.25	2.50	
4		4.50	6.21	1.17	3.17	1.50	1.25	3.17	2.25	
5		6.25	1.50	1.17	4.04	2.00	1.50	5.30	2.00	
6		6.50	2.83	4.08	5.25	2.50	1.25	.50	2.00	
7		7.25	3.17	1.50	5.58	2.50	1.50	2.00	2.00	
8		7.25	3.00	1.50	4.75	2.33	1.25	2.00	2.25	
9		7.00	3.42	6.00	4.17	2.50	1.50	2.00	2.00	
10		7.00	3.25	1.00	4.17	1.88	1.50	2.00		
11		7.25	5.42	1.50	3.67	1.00	1.50	2.25	1.75	
12		7.17	1.00	1.67	3.67	1.50	1.50	2.33	1.50	
13		6.67	1.67	1.75	4.00	2.08	1.50	2.33	1.50	
14			2.17	1.75	2.33	2.00	1.50	6.00	1.50	
15		6.25	2.25	2.33	3.00	2.33	1.00	2.00	1.50	
16		5.83	2.33	2.33	3.58	2.33	1.83	2.00	1.50	
17		5.50	3.17	2.58	3.08	5.21	1.83	2.25	1.25	
18		6.83	3.00	2.83	3.25	1.00	1.75	2.25	1.00	
19		6.62	2.92	2.75	2.75	1.25	1.75	2.33	1.00	
20		6.83	2.50	2.92	4.46	1.75	1.83	2.25		
21		5.67	2.50	2.67	1.00	1.25	1.75	2.25		
22		4.67	2.40	2.75	1.00	1.50		2.25		
23		4.00	2.40	2.75	1.92	1.75	1.50	2.00		
24		4.75	2.50	2.83	2.75	1.75	1.00	2.00		
25		3.00	2.50	2.83	3.17	1.75	1.00	1.75		
26	3.50	3.50	2.50	2.17	3.17	1.75	1.00	1.75		
27	3.75	5.88	2.50	5.12	5.58	6.50	1.00	1.75		
28	3.75	2.50	2.08	2.00	1.00	1.75		1.50		
29	4.00	2.50	2.17	2.00	.83	2.17		1.50		
30	3.75	4.00	1.75	1.00	3.25	2.17	3.00	1.50		
31			1.50		3.42	1.75		1.50		
1902.[b]										
1		2.67	6.00		2.00	1.00	1.00	1.17	7.17	1.83
2		2.33	5.84	1.00	2.25	.83	1.17	1.17		1.50
3		2.50	5.75	1.83	2.67		1.17	1.17	2.00	1.50
4		2.50		1.83	3.00	.83	1.17	1.00	2.25	1.50
5		2.33	5.92	2.50	4.50	1.00	1.00		2.50	1.33
6			5.33	2.58		1.17	1.00	1.00	2.67	1.17
7		2.33	4.67	4.96	4.33	1.00		1.00	2.83	
8		2.33	4.33		3.25	.83	.83	1.00	2.17	1.00
9		2.33	4.42	3.50	5.58	.67	.83	1.00		1.00
10	1.75	2.00	4.00	3.33	2.00		.83	.83	2.00	
11	1.75			3.00	2.00	1.00	.83	.83	2.54	
12	2.33	1.00	3.50	3.00	2.17	1.00	1.17		2.25	
13	2.25	1.00	4.50	3.00	2.17	1.00	1.25	1.00	3.96	
14	2.50	2.33	4.50	7.75	2.00	1.00		1.00	6.67	
15	2.83	2.83	4.17	2.25	2.17	.83	1.17	1.17	8.28	
16		4.75	3.67	2.50	2.17	2.88	1.17	1.00	9.00	
17		2.50	3.17	3.08	2.00		1.00	1.00	8.04	
18	3.33	1.67	2.67	2.33	1.83	.83	.83	2.92	6.75	
19	3.25	1.50	2.67	2.50	4.11	.83	.83		5.75	
20	3.00		2.33	3.00		.83	1.00	1.00	4.75	
21	2.83	1.42	2.33	5.34	1.67	.83		1.00	4.08	
22	2.67	1.83	2.67		1.67	1.00	1.17	1.00	3.75	
23		1.83	2.67	2.83	1.33	1.00	1.00	1.00		
24	2.58	1.83	4.92	3.00	1.67		1.00	1.00	3.25	
25	2.83	2.17		2.75	1.33	1.00	3.66	1.17	3.00	
26	2.83	3.50	1.92	2.83	1.17	1.00	1.00		2.75	
27	2.83		2.00	2.83		1.00	1.00	1.33	2.50	
28	3.25	7.75	2.17	5.29	1.17	1.00		1.33	2.00	
29	3.42	7.42	2.00		1.00	1.00	1.00	2.00	2.25	
30		6.50	1.83	1.33	.83	3.54	1.17	2.17	2.00	
31	3.17		6.12		.83	1.00		2.25		

[a] Ice conditions probably prevailed from January 1 to March 25 and November 20 to December 31, 1901.
[b] Ice conditions prevailed from January 1 to March 9 and December 10 to 31, 1902. There may also have been some slight effect from ice during the rest of March and December.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.[a]										
1		3.25	8.75	8.34	4.08	1.50	2.25	3.25		
2		3.42	8.50	7.54	4.83	1.50	2.75	3.25	2.00	
3		3.92	8.00	6.25	6.77	2.25	2.25	3.50	2.00	
4		4.29	7.88	5.50	9.58	2.88	2.00	5.75	1.75	
5			7.62	4.54	10.58	3.66		8.00	1.75	
6		4.00	7.04	3.79	10.04	5.12	2.25	7.96	1.50	
7		3.88	6.46	2.17	8.75	5.16	2.50	7.96	1.50	
8		4.25	5.50	2.75	7.50	7.58	2.80	7.62		
9		4.75	5.50	3.00	6.42	3.50	4.29	7.58	1.50	
10		4.58		2.54	5.29	3.66	4.66	6.88	1.50	
11		4.00	5.75	2.50	6.00	3.46	5.04		1.50	
12			8.62	2.42	6.00	3.12	7.73	6.25	1.50	
13		3.62	9.50	4.71	5.25	3.25	7.81	5.50	1.50	
14		4.50	9.42		4.46	3.17	10.50	5.17	1.50	
15		4.66	8.88	1.50	3.88	5.46	12.70	4.83		
16		4.62	7.83	1.50	3.54		13.25	4.04	1.50	
17		4.25		1.50	3.25	2.88	12.50	3.83	1.50	
18	4.50	3.75	6.12	1.25	6.38	2.38	11.00		1.50	
19	7.86		5.54	.50	1.00	1.88	9.25	3.75	1.25	
20	10.42	3.75	5.21	4.79	2.83	1.50	8.50	3.25		
21	9.25	3.38	5.34		2.50	1.50	7.00	3.25		
22		3.25	5.50	1.00	2.38	4.34	6.16	3.00		
23	7.75	2.92	5.21	1.25	2.25		5.25	3.00		
24	6.75	3.04		1.00	2.25	1.75	4.25	2.75		
25	5.25	5.50	6.00	.75	5.08	1.75	3.58			
26	4.66		7.02	.75		1.75	3.38	2.50		
27	4.42	3.84	9.21	3.88	2.12	1.75	3.25	2.25		
28	4.17	3.62	11.71		1.75	2.00	3.33	2.25		
29		4.00	12.30	1.50	1.50	2.25	3.25	2.25		
30	3.58	8.58	11.58	1.83	1.29	2.50	3.25	2.25		
31	3.50		10.04		1.12	2.25		2.00		
1904.[b]										
1				4.75	3.75	1.50	1.00	2.50	3.00	
2			5.25	3.75	4.33	1.50	2.00	2.00	3.00	
3			5.34	4.00		1.50	6.25	7.00	2.75	
4			5.00	6.38	4.17	1.50	4.00	2.00	2.83	
5			4.50		6.75	1.00	4.67	2.00	2.50	
6		5.00	4.62	7.28	7.00	1.00	4.17	1.50	2.67	
7		3.58	8.00	7.25	6.00		4.25	1.50	2.67	
8		5.00		6.71	5.66	.50	3.75	7.50	2.17	
9		5.50	5.25	5.92	3.00	.50	3.00		5.25	
10			5.50	5.00		3.84	6.12	10.50	2.00	
11		5.50	5.75	4.16	3.25	.50		11.75	2.00	
12		5.50	5.50		2.75	1.00	1.25	11.08	2.00	
13		5.25	5.50	4.17	2.50	1.00	1.75	9.00		
14		5.00	6.88	4.00	2.17		2.00	7.75	4.08	
15		4.50		3.58	2.00	.50	2.00	6.67	2.50	
16		3.75	4.50	4.70	2.00	.50	2.00	5.50	2.00	
17			3.75	2.50		.75	4.08	4.17	1.75	
18		3.75	3.50	2.00	1.75	.75		4.33	1.75	
19		4.50	3.83		1.75	.50	1.00	3.25	1.75	
20		4.00	3.25	2.25	1.75	4.00	.50	3.00	1.50	
21		4.00	5.25	2.75	3.38		.50	4.33	1.50	
22		4.00		2.75	1.50	.75	.75	7.44	1.50	
23		4.00	3.00	2.25	1.50	.50	1.00	5.25	1.50	
24		4.50	3.50	2.25		1.75	4.00	5.33	1.25	
25		5.83	6.34	5.66	1.50	1.83		4.50	1.25	
26		7.04	9.00		2.00	2.00	4.75	4.17	1.25	
27		7.00	10.25	4.25	2.00	4.54	4.00	4.33		
28		5.50	10.00	4.00	1.50		3.00	3.67	1.25	
29		5.62		3.75	1.75	1.00	7.75	3.67	1.25	
30		5.38	6.50		4.42	1.00	3.00	3.42		
31			4.75			1.00		3.25		

[a] Ice conditions prevailed from January 1 to March 19 and probably from November 19 to December 31, 1903.

[b] Ice conditions prevailed from January 1 to April 6 and from November 30 to December 31, 1904.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.[a]										
1		8.3	2.2	2.8	4.0	1.7	2.7	.....	2.25	2.08
2		7.5	2.4	3.7	4.2	1.6	2.8	2.50	2.42	2.08
3		7.8	2.5	3.0	7.5	1.4	2.0	4.46	2.25	2.25
4		6.5	2.9	4.7	2.5	1.2	3.0	1.50	2.00	2.50
5		6.7	3.5	7.5	3.9	1.5	3.1	1.50	.....	2.50
6		6.8	3.7	17.5	7.8	1.7	2.6	1.50	2.00	2.50
7		6.5	3.9	17.0	7.3	1.8	2.5	4.62	2.50	2.25
8		6.0	4.0	16.0	8.7	1.9	2.0	1.25	2.50	2.50
9		5.5	3.7	13.0	7.7	2.0	1.8	1.25	2.50	2.25
10		4.7	3.9	10.9	6.7	2.7	1.7	1.75	2.50	.....
11		4.9	4.1	9.8	6.1	2.5	1.6	2.25	2.75	2.0
12		4.1	4.0	8.8	2.4	2.3	2.3	5.21	.....	2.0
13		2.0	4.1	8.0	3.0	2.2	2.2	2.75	2.50	2.0
14		3.0	5.0	6.8	2.6	2.3	2.1	2.75	2.50	2.0
15		2.8	6.7	5.8	2.7	2.2	2.2	3.00	2.25	2.0
16		2.7	7.7	5.4	2.8	2.2	2.3	3.25	2.00	2.0
17		2.6	8.6	4.8	2.8	2.0	2.7	3.75	2.00	.....
18		2.3	8.0	7.6	2.7	2.1	4.5	4.33	2.75	2.0
19		2.1	7.0	6.7	3.0	2.0	3.0	4.50	.....	2.0
20		2.0	6.5	7.4	2.8	2.2	5.0	5.50	2.00	2.0
21		1.8	5.4	7.0	2.5	3.5	7.5	5.25	1.83	2.0
22		1.7	5.0	5.9	2.3	3.6	7.0	.....	1.83	.....
23	2.0	1.2	4.9	5.3	2.4	2.3	5.8	4.50	1.75	.....
24	2.8	2.0	4.2	5.3	2.5	2.4	5.0	4.33	1.75	.....
25	3.0	1.8	4.5	6.5	2.4	2.7	3.0	4.25	2.33	.....
26	3.5	1.9	3.8	3.0	2.3	2.0	4.5	3.33	.....	.....
27	4.5	1.8	4.0	2.9	2.1	2.3	2.3	3.25	2.50	.....
28	5.4	1.6	3.7	3.5	1.9	2.0	2.6	3.25	2.50	.....
29	7.9	1.5	3.6	3.3	1.7	2.5	2.5	.....	2.33	.....
30	9.5	1.7	3.7	2.2	1.6	2.6	2.4	3.00	2.17	.....
31	9.0	.....	3.0	.....	1.5	2.5	.....	2.50	.....	.....
1906.[b]										
1		.....	4.00	7.96	.....	4.00	4.34	1.50	3.83	3.33
2		1.33	4.00	2.08	5.00	1.00	.83	1.75	3.50	.....
3		6.21	4.17	.....	3.33	1.00	.83	4.92	3.33	2.75
4		6.83	4.25	3.00	2.08	1.00	4.25	1.75	3.00	2.50
5		8.67	6.50	3.50	1.83	1.00	1.50	1.50	3.00	.....
6		7.92	.....	3.00	2.17	1.17	1.25	1.25	3.00	.....
7		7.83	5.25	3.50	4.46	5.38	1.50	.....	3.00	.....
8		8.00	.78	6.00	1.00	1.50	1.25	1.00	3.00	.....
9		9.04	2.25	6.17	1.67	2.00	1.25	1.17	3.75	.....
10		9.75	2.25	5.50	1.83	4.62	3.66	1.17	3.75	.....
11		9.58	1.83	4.83	4.42	1.50	1.33	4.92	.....	.....
12		9.21	1.75	5.00	1.75	.....	1.33	1.25	3.33	.....
13		9.54	.....	4.00	1.50	4.34	1.50	1.25	3.08	.....
14		10.45	7.42	4.00	1.75	1.50	1.83	.....	3.00	.....
15		11.50	5.67	3.42	2.00	1.17	3.00	1.50	3.00	.....
16		11.00	4.50	3.17	2.00	.92	3.17	1.67	3.00	.....
17		10.00	2.33	2.50	2.75	1.00	6.75	1.75	2.50	.....
18		9.16	4.00	4.84	1.75	3.84	3.50	1.75	.....	.....
19		8.67	4.00	1.67	1.83	.....	2.33	1.50	3.33	.....
20		8.17	2.25	1.67	2.00	1.00	2.83	1.50	3.00	.....
21		8.00	4.88	1.83	2.00	1.00	2.50	.....	3.00	.....
22		7.50	1.50	2.00	1.25	2.25	2.67	2.00	3.00	.....
23		7.33	3.75	4.79	1.25	5.75	3.00	2.25	3.00	.....
24		6.83	7.00	.....	1.25	1.50	6.50	3.33	.....	.....
25		6.33	2.25	1.50	4.29	5.88	2.08	3.00	.....	.....
26		6.00	3.75	2.25	1.50	.....	2.25	5.08	2.00	.....
27		5.33	.....	2.83	1.25	6.08	2.50	5.00	2.92	.....
28		5.17	7.00	3.00	1.42	1.83	2.25	5.00	3.17	.....
29		4.17	6.67	3.33	1.08	4.46	2.00	4.83	3.25	.....
30		4.17	6.17	1.75	.83	1.83	1.75	4.50	3.33	.....
31		.....	5.50	.....	1.17	1.83	.....	4.00	.....	.....

[a] No notes regarding ice conditions are available. Ice conditions are assumed to have prevailed from January 1 to March 22 and December 22 to 31, 1905.

[b] The above gage heights for 1906 supersede those published in Water-Supply Paper 207, and are considered to give somewhat better results when compared with the discharge at Eau Claire. Ice conditions prevailed from January 1 to March 31 and throughout the greater portion of December, 1906.

Daily gage height, in feet, of Chippewa Falls at Chippewa Falls, Wis., for 1899 to 1908—Continued.

[N. O. Swift, observer, 1907 and 1908.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1		9.5	3.9	4.0	2.2	1.0	0.8	2.8	1.3	0.9
2		8.0	4.0	3.9	2.1	1.1	.9	2.8	1.4	.9
3		7.5	3.9	3.5	2.2	1.2	.8	2.0	1.4	.9
4		7.3	4.2	3.4	2.3	1.0	.7	1.7	1.4	.9
5		8.0	4.0	3.3	3.2	1.2	.8	1.9	1.3	.9
6		7.9	3.9	2.5	3.5	1.3	.7	1.7	1.4	1.0
7		7.5	3.8	3.0	2.9	1.2	.8	1.8	1.5	1.0
8		6.9	3.9	3.3	2.4	1.3	.7	1.5	1.3	1.0
9		6.6	3.8	2.7	2.3	1.2	.6	1.4	1.1	1.0
10		5.5	3.7	2.5	2.1	1.3	.7	1.5	1.1	1.0
11		5.4	3.8	2.7	2.2	1.2	.8	1.3	1.3	1.0
12		5.0	3.5	2.9	1.9	1.1	.9	1.3	1.3	1.0
13		5.2	3.4	2.4	1.7	1.3	.8	1.3	1.3	1.0
14		4.4	3.7	2.5	1.6	1.1	.7	1.7	1.4	1.0
15		4.3	5.5	2.8	1.4	1.0	.8	1.7	1.4	1.0
16		4.2	5.9	2.7	1.5	1.1	.9	1.8	1.4	1.0
17	2.0	3.9	6.6	2.6	1.6	1.0	1.0	1.5	1.5	1.0
18	1.8	3.8	6.5	2.4	1.4	.9	1.1	1.3	1.4	1.0
19	1.7	3.6	6.0	2.5	1.6	1.0	4.0	1.3	1.4	1.0
20	2.2	3.5	5.3	2.3	1.7	1.2	8.3	1.4	1.4	1.0
21	2.3	3.4	5.2	2.2	1.3	1.3	10.0	1.5	1.3	.9
22	2.5	3.3	4.8	2.1	1.9	1.2	9.5	1.5	1.3	.9
23	3.5	2.9	4.5	2.2	1.8	1.1	8.4	1.5	1.3	.9
24	4.0	2.8	4.3	2.4	1.6	1.0	7.3	1.5	1.2	.9
25	4.5	3.6	4.7	3.4	1.5	1.1	4.3	1.3	1.2	.9
26	6.5	4.0	4.9	3.0	1.3	1.0	6.9	1.1	1.1	.9
27	7.0	3.8	4.4	2.7	1.2	.9	4.2	1.1	1.1	.9
28	9.0	3.9	4.7	2.6	1.1	1.0	4.7	1.1	1.0	.9
29	10.0	3.8	3.5	2.4	1.0	.9	2.7	1.1	1.0	1.0
30	11.0	4.0	4.0	2.3	1.7	.8	4.4	1.2	.9	1.0
31	10.9	.....	4.1	.....	1.0	.9	.....	1.3	.....	1.0

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[b]												
1	1.0	0.8	0.9	1.5	7.6	6.5	2.0	1.5	1.1	1.3	1.3	1.3
2	1.0	.8	.9	1.4	7.1	5.5	2.1	1.6	1.0	1.2	1.4	1.3
3	1.0	.8	.9	1.5	6.4	5.1	2.2	1.7	1.1	1.1	1.4	1.3
4	1.0	.8	.9	1.6	6.0	4.3	2.0	1.8	1.0	.7	1.3	1.3
5	1.0	.8	.9	1.8	5.4	4.2	1.9	1.9	1.1	1.1	1.3	1.3
6	1.0	.8	.9	2.0	5.0	3.4	2.1	1.4	.7	1.0	1.3	1.3
7	1.0	.7	.9	2.9	4.7	3.1	1.9	1.3	.6	1.1	1.3	1.3
8	1.0	.6	.8	3.5	4.3	3.3	1.7	1.4	1.0	1.0	1.3	1.3
9	1.0	.5	.7	3.0	4.0	3.8	2.2	1.3	1.1	.9	1.3	1.3
10	.9	.4	.7	3.4	3.8	4.4	2.0	1.4	1.3	1.0	1.2	1.3
11	.9	.4	.7	3.8	3.4	4.3	1.7	1.3	1.2	.8	1.1	1.3
12	.9	.5	.7	3.9	3.3	3.9	1.6	1.4	1.1	1.2	1.0	1.2
13	.8	.7	.7	4.3	3.7	4.3	1.7	1.3	.8	1.1	.9	1.2
14	.8	1.1	.7	4.4	3.8	4.4	1.6	1.2	.9	1.0	.9	1.2
15	.8	1.1	.7	4.5	3.9	5.0	1.5	1.3	.8	1.1	.9	1.2
16	.8	1.0	.8	5.6	4.0	4.5	1.3	1.5	.9	1.0	.9	1.2
17	.7	1.0	.8	5.5	3.9	3.8	1.4	1.4	.7	.9	.9	1.2
18	.7	.9	.8	5.6	3.8	3.3	1.3	1.3	.8	.7	.9	1.2
19	.8	.9	.8	5.7	4.6	3.0	1.4	1.4	1.0	.9	.9	1.2
20	.8	.8	.9	6.0	6.3	2.7	1.7	1.3	.7	1.0	.9	1.2
21	.8	.7	1.0	5.9	6.9	2.5	1.9	1.2	1.0	.9	.9	1.1
22	.8	.7	1.2	5.7	7.1	2.7	1.6	1.3	.9	1.0	.8	1.1
23	.8	.8	1.4	5.3	7.6	2.4	1.5	1.0	1.0	1.1	.8	1.1
24	.8	.9	1.7	5.0	7.7	2.7	1.4	1.3	.9	1.2	.8	1.1
25	.8	.9	1.8	5.3	7.8	4.0	1.9	1.0	1.0	1.1	.9	1.0
26	.8	.9	1.7	6.4	7.9	2.9	1.5	1.1	.9	1.2	.9	1.0
27	.8	.9	1.7	7.2	8.0	3.0	1.4	1.2	.8	1.3	1.0	1.0
28	.8	.9	1.6	8.3	7.7	2.1	1.5	1.1	1.2	1.2	1.2	.9
29	.8	.9	1.5	8.9	7.0	2.3	1.4	1.0	1.1	1.3	1.3	.9
30	.8	.....	1.5	8.4	6.3	1.9	2.1	1.1	1.0	1.4	1.3	.9
31	.8	.....	1.4	.....	6.4	.....	2.4	1.0	.....	1.4	.....	1.1

[a] River frozen January 1 to March 16, and from about December 6 to 31, 1907.
[b] River frozen January 1 to March 20 and during December, 1908. Readings during the frozen periods are to water surface.

Rating tables for Chippewa River at Chippewa Falls, Wis.

1899 TO 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	500	1.50	3,110	3.00	6,850	6.00	16,550
.10	600	1.60	3,340	3.20	7,420	7.00	20,350
.20	710	1.70	3,570	3.40	8,000	8.00	24,250
.30	840	1.80	3,800	3.60	8,600	9.00	28,250
.40	980	1.90	4,040	3.80	9,200	10.00	32,300
.50	1,130	2.00	4,280	4.00	9,800	11.00	36,400
.60	1,290	2.10	4,520	4.20	10,420	12.00	40,600
.70	1,460	2.20	4,760	4.40	11,050	13.00	44,800
.80	1,640	2.30	5,010	4.60	11,690	14.00	49,100
.90	1,830	2.40	5,260	4.80	12,340	15.00	53,400
1.00	2,030	2.50	5,510	5.00	13,000	16.00	57,800
1.10	2,240	2.60	5,770	5.20	13,680	17.00	62,200
1.20	2,450	2.70	6,030	5.40	14,380	18.00	66,700
1.30	2,670	2.80	6,300	5.60	15,090		
1.40	2,890	2.90	6,570	5.80	15,810		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 16 discharge measurements made during 1906 to 1908 and is well defined between gage heights 1.0 foot and 11 feet. Comparisons with the discharge at Eau Claire indicate that this table is applicable to Chippewa Falls gage heights with equal accuracy for all years 1903 to 1908 (except 1905) and hence it is assumed to apply correctly for 1899 to 1902. (See fig. 1.)

JANUARY 1, 1908, TO MARCH 20, 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	900	.80	1,300
.50	1,000	.90	1,400
.60	1,100	1.00	1,500
.70	1,200	1.10	1,600

NOTE.—The above table is applicable only for ice conditions from January 1 to March 20, 1908. It is based on two discharge measurements made during 1908 and is approximate only.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908.

[Drainage area, 5,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1899.[a]						
April 10-30	26,200	5,110	12,700	2.40	1.87	A.
May	27,200	3,870	13,100	2.47	2.85	A.
June	20,400	3,870	10,600	2.00	2.23	A.
July	15,500	120	3,910	.738	.85	A.
August	18,400	1,550	3,540	.668	.77	A.
September	10,600	1,800	2,710	.511	.57	A.
October	20,800	1,130	4,700	.887	1.02	A.
November	5,950	2,560	3,480	.657	.73	A.
1900.[a]						
April 7-30	40,400	4,690	16,000	3.02	2.70	A.
May	17,500	2,560	7,180	1.35	1.56	A.
June	10,700	1,550	2,610	.492	.55	A.
July	23,300	2,120	6,810	1.28	1.48	A.
August	29,800	3,110	9,800	1.85	2.13	A.
September	44,800	5,510	17,700	3.34	3.73	A.
October	45,500	4,280	15,600	2.94	3.39	A.
November 1-24	31,300	4,880	11,500	2.17	1.94	A.

[a] Discharge estimated for days when the gage was not read.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908—Con.

Month.	Discharge in second-feet.				Run-off (depth in inches in drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1901.[a]						
March 26–31	9,800	7,950	8,870	1.67	.37	A.
April	21,300	5,510	14,800	2.79	3.11	A.
May	17,300	3,110	6,480	1.22	1.41	A.
June	16,600	2,030	5,210	.983	1.10	A.
July	15,000	1,700	7,900	1.49	1.72	A.
August	18,400	2,030	5,490	1.03	1.19	A.
September	6,850	2,030	3,030	.572	.64	A.
October	16,600	1,130	5,260	.992	1.14	A.
November 1–19	5,510	2,030	3,710	.700	.49	A.
1902.[a]						
March 10–31	8,060	3,680	6,330	1.19	.97	A.
April	23,300	2,030	6,830	1.29	1.44	A.
May	17,000	3,870	9,470	1.79	2.06	A.
June	23,300	2,000	6,960	1.31	1.46	A.
July	15,000	1,700	5,160	.974	1.12	A.
August	8,420	1,410	2,250	.425	.49	A.
September	8,780	1,700	2,300	.434	.48	A.
October	6,630	1,700	2,520	.475	.55	A.
November	28,200	4,000	9,890	1.87	2.09	A.
December 1–9	3,870	2,030	2,730	.515	.17	A.
1903.[a]						
March 18–31	32,800	8,300	17,100	3.23	1.68	A.
April	26,600	6,630	10,200	1.92	2.14	A.
May	41,900	13,700	22,700	4.28	4.93	A.
June	25,600	1,130	7,040	1.33	1.48	A.
July	34,700	2,030	12,400	2.34	2.70	A.
August	22,600	3 000	6,900	1.30	1.50	A.
September	45,900	4,280	16,400	3.09	3.45	A.
October	24,200	4,280	11,700	2.21	2.55	A.
November 1–19	4,280	2,560	3,330	.628	.44	A.
1904.[a]						
April 6–30	20,500	8,540	12,900	2.43	2.26	A.
May	33,300	6,850	15,100	2.85	3.29	A.
June	21,400	4,280	11,000	2.08	2.32	A.
July	20,400	3,000	7,220	1.36	1.57	A.
August	11,500	1,130	2,840	.536	.62	A.
September	23,300	1,130	7,370	1.39	1.55	A.
October	39,600	3,110	14,600	2.75	3.17	A.
November	13,900	2,560	4,690	.885	.99	A.
1905.[a]						
March 23–31	30,200	4,280	14,900	2.81	.94	A.
April	25,400	2,450	9,720	1.83	2.04	A.
May	26,600	4,760	11,800	2.23	2.57	A.
June	64,400	4,760	21,600	4.08	4.55	A.
July	27,000	3,110	9,530	1.80	2.08	A.
August	8,600	2,450	4,780	.902	1.04	A.
September	22,300	3,340	7,650	1.44	1.61	A.
October	14,700	2,560	7,890	1.49	1.72	A.
November	6,160	3,680	4,870	.919	1.03	A.
December 1–21	5,510	4,280	4,630	.874	.68	A.
1906.[a]						
April	38,500	10,300	23,400	4.42	4.93	A.
May	22,000	3,110	11,400	2.15	2.48	A.
June	24,100	2,600	8,660	1.63	1.82	A.
July	13,000	1,700	4,660	.879	1.01	A.
August	16,800	1,870	5,820	1.10	1.27	A.
September	19,400	1,700	5,930	1.12	1.25	A.
October	13,300	2,030	5,780	1.09	1.26	A.
November	9,290	4,280	7,050	1.33	1.48	A.
1907.						
March 17–31	36,400	3,570	15,200	2.87	1.60	A.
April	30,200	6,300	13,900	2.62	2.92	A.
May	18,800	8,000	11,400	2.15	2.48	A.
June	9,800	4,520	6,280	1.18	1.32	A.
July	8,300	2,030	3,970	.749	.86	A.
August	2,670	1,640	2,230	.421	.49	A.
September	32,300	1,290	8,170	1.54	1.72	A.
October	6,300	2,240	3,240	.611	.70	A.
November	3,110	1,830	2,630	.496	.55	A.
December[b]	.....	.....	1,600	.302	.35	C.

[a] Discharge estimated for days when the gage was not read.
[b] Discharge December, 1907, estimated on the basis of one measurement made under ice conditions during the month.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for 1899 to 1908—Con.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1908.						
January	1,500	1,200	1,360	.257	.30	C.
February	1,720	900	1,300	.245	.26	C.
March	3,800	1,200	1,950	.368	.42	B.
April	27,800	2,890	12,300	2.32	2.59	A.
May	24,200	7,710	15,700	2.96	3.41	A.
June	18,400	4,040	8,880	1.68	1.87	A.
July	5,260	2,670	3,670	.692	.80	A.
August	4,040	2,030	2,730	.515	.59	A.
September	2,670	1,290	1,950	.368	.41	A.
October	2,890	1,460	2,190	.413	.48	A.
November	2 890	1,640	2,200	.415	.46	A.
December[a]			1,500	.283	.33	D.
The year	27,800	900	4,640	.876	11.92	

[a] Discharge December, 1908, based on discharge at Eau Claire.

CHIPPEWA RIVER NEAR EAU CLAIRE, WIS.

This station, which is located at the highway bridge at Shawtown, about 2 miles below Eau Claire, Wis., was established November 13, 1902, to obtain data for water-power and storage problems.

Eau Claire River enters from the east about 3 miles above the station. Winter conditions are severe in this vicinity. Ice forms to a thickness of 1 to 2 feet, and greatly modifies the relations between discharge and gage heights. The normal flow of the stream is very materially affected by the power plants at Eau Claire and Chippewa Falls, and by the holding and releasing of storage water for logging.

Except as noted the records are reliable and accurate, and the estimates of the flow should be good. The datum of the gage has remained unchanged.

Information in regard to this station prior to 1908 is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Chippewa River near Eau Claire, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 2	A. H. Horton	450	5,670	11.78	26,700
May 5	do	364	3,880	7.50	10,900
June 15	G. A. Gray	351	3,430	6.06	6,910
July 15	do	334	2,970	5.37	4,640
August 16	do	167	1,900	4.21	2,420
September 19	do	375	4,050	8.00	12,100
September 22	do	466	6,380	12.92	27,900
September 27	do	371	4,210	7.95	11,900
October 21	do	197	2,340	4.77	3,410
Do	do	197	2,290	4.87	3,520
November 16	do	222	2,230	4.60	3,340
December 19[a]	do	207	2,180	3.90	2,470
1908.					
January 22[b]	G. A. Gray	187	1,680	4.00	2,190
February 15[c]	do	330	2,670	4.65	2,690
September 11	do	317	2,670	3.90	1,960

[a] Ice conditions and discharge partly estimated.
[b] Ice 30 to 35 feet wide at both shores.
[c] Ice measurement; ice 0.8 foot thick.

Daily gage height, in feet, of Chippewa River near Eau Claire, Wis., for 1907 and 1908.

[Jos. E. Kimpton, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	5.00			13.48	7.56	7.59	5.72	4.10	3.79	6.38	5.02	4.31
2	6.86			12.26	7.50	7.34	5.78	4.25	4.04	6.89	5.65	3.52
3	4.74			11.05	7.42	7.06	5.80	4.20	4.34	6.62	5.18	3.66
4	4.81			11.03	7.65	6.86	5.60	3.80	4.34	5.61	5.12	3.60
5	4.72			11.65	7.52	6.74	6.47	4.53	4.32	5.72	4.45	3.57
6	4.58			11.48	7.24	6.18	8.34	4.40	4.20	5.56	5.15	4.22
7	4.78			11.19	7.07	6.62	7.90	4.38	4.16	6.46	5.90	4.35
8	4.81			10.38	7.30	6.52	6.76	4.45	3.74	5.60	5.78	3.52
9	4.96			9.94	7.26	6.04	6.34	4.59	4.01	5.28	4.80	4.26
10	5.02			9.51	7.25	6.15	6.04	4.48	4.18	5.38	4.85	4.42
11	4.97			9.02	7.20	6.29	5.40	4.38	4.40	5.46	4.16	4.32
12	4.71			8.74	6.58	5.84	5.18	4.97	4.34	4.82	4.38	4.34
13	4.69			8.52	6.93	5.94	5.12	5.10	4.52	4.59	5.02	4.30
14	5.01		4.80	7.98	7.58	6.13	4.38	4.21	4.04	4.98	4.40	4.16
15	5.20		4.79	8.19	9.18	6.12	5.20	4.20	3.92	5.45	4.44	3.35
16	5.10		5.08	7.66	9.54	6.40	5.90	4.21	4.10	7.00	4.58	3.86
17	5.39		4.86	7.24	9.98	6.39	5.70	4.80	4.48	5.46	4.44	4.20
18	4.80		4.98	7.38	9.46	5.98	4.61	3.80	4.56	4.72	5.20	2.90
19	5.17		5.58	7.19	9.26	6.10	5.05	5.08	8.12	4.70	4.67	4.55
20			5.75	6.82	8.71	5.83	5.32	5.98	12.22	4.70	4.74	3.87
21			6.45	6.48	8.50	5.73	4.57	5.24	13.85	5.26	4.87	4.02
22			6.42	6.86	8.26	5.53	5.48	4.94	12.92	4.84	4.82	3.26
23			7.98	6.28	7.51	5.64	5.46	4.66	11.62	4.66	4.68	3.60
24			8.38	7.11	8.68	6.17	5.03	4.69	10.55	5.42	4.48	4.24
25			10.16	7.17	8.50	6.54	5.12	5.15	9.22	5.35	4.76	3.30
26			12.07	7.32	8.91	6.46	4.82	4.42	8.32	5.18	4.64	4.00
27			13.41	7.32	8.18	6.25	4.64	4.64	8.08	4.40	4.66	3.83
28			14.58	7.11	9.05	5.97	4.63	4.49	8.09	3.97	4.42	3.82
29			14.34	7.23	7.72	5.96	5.04	4.41	7.20	4.65	4.52	3.16
30			15.00	7.12	7.88	5.68	5.26	4.56	7.75	4.66	4.36	3.96
31			15.04		7.66		4.13	4.20		4.68		
1908.[b]												
1			3.28	4.89	11.13	10.23	5.50	5.40	4.68	3.67	4.26	4.00
2		3.3	3.91	4.98	10.60	9.00	5.65	5.28	5.40	3.62	4.29	3.64
3			3.92	5.10	9.88	8.20	5.56	4.98	5.28	3.78	4.33	3.75
4			4.26	5.43	9.38	7.78	5.14	4.92	4.98	3.86	4.28	3.87
5			4.46	4.93	8.74	7.20	5.23	6.56	4.92	3.89	4.28	3.68
6		4.2	3.84	5.14	8.39	7.28	5.66	5.53	5.48	3.86	4.22	3.32
7			4.11	6.22	8.10	6.77	5.72	5.00	5.00	3.86	4.22	
8			3.37	6.54	7.67	6.94	6.64	4.67	4.64	3.77	3.34	
9			4.35	6.49	7.28	7.64	6.78	3.70	3.70	4.49	3.59	
10			3.76	6.72	7.36	8.41	6.72	4.45	3.74	4.34	3.99	4.10
11		3.55	3.87	7.39	6.74	7.84	5.96	4.56	3.70	3.40	3.70	3.98
12			4.48	7.68	6.52	7.46	4.68	4.54		3.82	4.14	3.98
13			5.00	7.75	6.88	8.10	5.48	4.82		3.88	4.13	3.52
14		4.7	4.60	7.92	7.21	8.96	5.12	4.82	4.01	3.74	4.18	4.04
15	3.95	4.65	4.36	8.23	7.51	8.94	4.73	5.45	3.96	3.69	3.95	4.05
16			5.66	8.80	7.67	8.21	4.30	5.52	3.85	3.86	3.56	4.70
17		4.55	5.01	8.88	7.56	6.87	4.81	4.18	3.65	3.89	3.56	3.98
18	4.08		4.86	8.80	7.60	7.35	4.66	4.80	3.60	3.51	4.35	3.91
19			4.69	8.82	7.93	7.15	4.10	3.86	3.50	3.51	4.60	3.78
20			4.40	9.40	10.09	6.81	5.40	3.76	3.58	3.61	4.65	3.38
21	4.5		4.32	9.22	10.50	6.81	6.08	3.80	3.94	3.77	4.70	3.59
22	4.0	4.15	4.45	8.85	10.52	7.14	5.02	3.80	3.93	3.80	4.55	4.19
23			5.15	8.49	11.06	6.54	4.95	5.14	3.82	3.94	4.55	4.15
24		4.5	5.08	8.31	11.82	7.10	4.52	5.00	3.83	3.80	4.11	3.68
25	3.8	4.19		8.82	11.42	8.85	6.57	3.91	3.74	3.68	4.19	3.45
26		4.32		9.75	11.99	6.91	5.12	4.15	3.58	3.83	4.48	3.30
27		4.49		10.77	12.38	6.32	4.66	4.45	3.52	4.05	4.20	4.06
28	3.9	4.43		12.07	11.30	6.15	5.10	3.88	3.42	4.24	4.41	3.90
29		4.23		12.64	9.95	8.65	5.32	3.81	3.46	4.24	4.20	4.15
30				12.15	8.32	5.54	6.54	3.76	3.52	4.47	4.17	3.92
31					10.14		4.99	3.77		4.36		

[a] Frozen January 20 to March 13, 1907. Ice conditions during part of December, 1907.
[b] Stream frozen January 1 to February 24, December 7 to 9, and December 31, 1908.

Rating table for Chippewa River near Eau Claire, Wis., for 1906 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	310	4.30	2,540	5.60	5,500	7.80	11,730
3.10	440	4.40	2,740	5.70	5,760	8.00	12,350
3.20	600	4.50	2,950	5.80	6,020	8.20	12,970
3.30	750	4.60	3,160	5.90	6,280	8.40	13,600
3.40	900	4.70	3,380	6.00	6,550	8.60	14,240
3.50	1,050	4.80	3,600	6.20	7,090	8.80	14,890
3.60	1,210	4.90	3,820	6.40	7,640	9.00	15,550
3.70	1,390	5.00	4,050	6.60	8,200	10.00	18,950
3.80	1,570	5.10	4,280	6.80	8,770	11.00	22,550
3.90	1,760	5.20	4,520	7.00	9,350	12.00	26,350
4.00	1,950	5.30	4,760	7.20	9,930	13.00	30,350
4.10	2,140	5.40	5,000	7.40	10,530	14.00	34,500
4.20	2,340	5.50	5,250	7.60	11,130	15.00	38,750

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1902 to 1908, and is well defined between gage heights 4 feet and 15 feet.

Monthly discharge of Chippewa River near Eau Claire, Wis., for 1907 and 1908.

[Drainage area, 6,740 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.[a]						
January 1–19	8,940	3,120	4,130	0.613	0.43	A.
March 14–31	38,900	3,580	16,700	2.48	1.66	A.
April	32,300	7,310	15,100	2.24	2.50	A.
May	18,900	8,140	12,500	1.85	2.13	A.
June	11,100	5,320	7,310	1.08	1.20	A.
July	13,400	2,200	5,400	.801	.92	A.
August	6,500	1,570	3,310	.491	.57	A.
September	33,900	1,460	8,930	1.32	1.47	A.
October	9,350	1,890	4,870	.723	.83	A.
November	6,280	2,260	3,640	.540	.61	A.
December	3,060	190	1,770	.265	.30	C.
1908.[b]						
January			2,100	.312	.36	D.
February			2,200	.326	.35	D.
March	5,710	720	3,260	.484	.56	A.
April	28,900	3,800	12,900	1.91	2.13	A.
May	27,800	7,980	16,400	2.43	2.80	A.
June	19,800	5,350	11,100	1.65	1.84	A.
July	8,710	2,140	5,040	.748	.86	A.
August	8,090	1,390	3,230	.479	.55	A.
September	5,200	930	2,160	.320	.36	B.
October	2,930	900	1,730	.257	.30	B.
November	3,380	810	2,310	.343	.38	B.
December	3,380	750	1,680	.249	.29	C.
The year	28,900	720	5,340	.792	10.78	

[a] Open-channel rating applied for December, 1907; discharge probably somewhat too high.
[b] Discharge January 1 to February 24, 1908, based on two measurements made under ice conditions and the discharge at Chippewa Falls. Open-channel rating applied December, 1908; discharge probably somewhat too high.

RED CEDAR RIVER AT MENOMINEE, WIS.

This station, which is located at a highway bridge west of Menominee, about 200 rods from the Chicago and Northwestern Railroad depot, was established June 17, 1907, to obtain data for water power and storage problems. It was discontinued September 17, 1908.

No important tributaries enter Red Cedar River in the immediate vicinity of this station. A power plant with large reservoir storage capacity a short distance above the station modifies the flow and causes considerable fluctuation in the water surface at the gage.

Winter conditions are severe in this vicinity, but ice does not affect the discharge to any important extent.

The datum of the gage has remained unchanged and the records are reliable and accurate. A fairly good rating curve has been developed.

Information in regard to this station, prior to 1908, is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Red Cedar River at Menominee, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 18	G. A. Gray	189	860	2.85	1,330
July 16	do	196	942	3.94	2,490
August 20	do	202	991	4.35	2,500
September 20	do	205	1,210	5.60	4,550
October 22	do	185	710	2.43	782
Do	do	181	656	2.10	657
November 18	do	189	784	3.00	1,270
December 21	do	180	658	2.40	686
1908.					
January 25[a]	G. A. Gray	185	758	2.85	866
February 17	do	190	848	3.40	1,500
Do	do	190	848	3.42	1,520
September 9	do	188	776	2.60	936

[a] Plots about 80 per cent of the open-channel rating curve; probably due to ice below the station.

Daily gage height, in feet, of Red Cedar River at Menominee, Wis., for 1907 and 1908.

[H. H. Fuller, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.								1907.							
1	.....	3.42	2.84	3.09	3.82	2.95	2.70	16	.....	4.10	2.71	2.88	3.25	2.50	2.55
2	.....	4.52	2.78	2.99	3.48	3.35	2.48	17	2.50	5.96	2.70	2.90	3.64	2.95	2.55
3	.....	4.62	2.81	2.98	3.30	3.10	2.90	18	2.74	5.32	2.72	2.62	2.70	2.95	2.50
4	.....	3.68	2.72	2.88	3.38	3.15	2.52	19	2.74	4.10	4.42	5.14	2.85	3.00	2.65
5	.....	3.28	2.79	2.80	3.21	2.85	2.48	20	2.78	3.80	4.28	5.66	2.60	2.85	1.10
6	.....	4.06	3.01	2.70	3.12	2.80	2.41	21	2.69	3.58	3.88	6.65	3.15	2.76	3.08
7	.....	3.51	2.91	2.74	3.08	3.10	2.69	22	2.80	3.50	3.45	5.72	2.60	2.84	2.60
8	.....	3.18	2.80	2.68	3.09	.50	2.82	23	3.00	4.19	3.08	4.70	2.68	2.95	2.75
9	.....	3.31	2.75	2.71	3.25	1.45	3.02	24	3.04	3.65	3.04	4.16	2.72	2.82	2.55
10	.....	3.30	2.78	2.76	2.96	2.70	2.95	25	3.00	3.15	3.00	4.12	2.71	2.85	2.70
11	.....	3.14	2.76	2.69	3.18	2.78	2.55	26	2.90	3.09	2.89	4.14	2.74	2.91	2.38
12	.....	2.96	2.65	2.66	3.08	2.72	2.62	27	2.82	2.99	2.90	3.62	2.72	2.75	2.58
13	.....	2.89	2.65	2.65	3.20	2.68	2.48	28	2.75	2.95	2.86	3.22	2.92	2.82	2.80
14	.....	2.84	2.68	2.68	3.30	2.35	2.30	29	2.75	2.88	3.00	3.58	2.92	2.78	2.65
15	.....	3.05	2.72	2.64	2.75	2.52	2.35	30	2.88	2.82	2.99	3.30	2.15	2.50	2.90
								31	.....	2.88	3.09	.....	3.04	.....	2.52

Daily gage height, in feet, of Red Cedar River at Menominee, Wis., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1908.									
1	2.58	2.88	2.50	3.28	4.55	5.15	2.15	2.25	2.05
2	2.65	2.72	2.78	3.60	4.45	3.90	2.38	2.30	2.15
3	2.82	2.85	2.80	3.25	4.25	3.50	2.05	2.12	2.10
4	2.65	3.00	2.65	3.33	4.40	3.35	2.35	2.15	.....
5	2.75	3.00	2.65	3.47	4.15	3.35	2.20	2.28	.....
6	2.65	2.85	2.65	3.80	3.55	3.70	2.15	2.30	.....
7	2.55	2.85	2.65	3.55	3.40	3.25	2.20	2.45	.....
8	2.68	2.65	2.68	3.37	3.15	3.10	2.45	2.35	.....
9	2.65	.....	2.95	3.77	3.08	3.45	2.30	2.40	.....
10	2.40	.....	2.75	3.65	3.65	3.30	2.20	2.22	.....
11	2.55	.....	2.90	3.45	3.18	3.28	2.60	2.28	.....
12	2.80	3.10	3.80	3.80	3.08	3.50	2.65	2.35	.....
13	2.75	3.58	4.45	3.70	3.42	3.60	2.70	2.50	.....
14	2.62	3.72	4.75	3.30	3.10	4.05	2.70	2.35	.....
15	2.55	3.68	3.55	3.63	2.92	4.30	2.70	2.25	.....
16	2.65	3.85	3.35	3.72	2.50	4.55	2.45	2.22	.....
17	2.45	3.20	3.15	3.65	3.12	4.10	2.50	2.28	.....
18	2.50	2.90	2.70	3.42	3.30	3.45	2.35	2.35	.....
19	2.55	3.02	2.25	3.65	3.25	3.48	2.55	2.30	.....
20	2.65	2.75	2.62	3.93	3.33	3.40	2.55	2.50	.....
21	2.70	2.55	2.70	3.55	2.70	2.90	2.78	2.40	.....
22	3.05	2.72	2.72	3.30	3.25	3.30	2.88	2.45	.....
23	2.85	2.60	4.58	2.98	2.83	3.40	2.95	2.25	.....
24	2.85	2.68	4.95	3.30	3.30	3.15	3.02	2.15	.....
25	2.55	2.88	4.82	3.63	2.50	4.05	3.02	2.15	.....
26	2.35	2.75	3.85	4.70	3.85	3.95	3.02	2.22	.....
27	2.50	2.68	3.68	5.95	4.50	3.60	2.78	2.22	.....
28	2.15	2.58	3.28	5.78	4.35	4.10	2.40	2.20	.....
29	2.45	2.75	3.25	5.45	5.02	4.30	2.38	2.25	.....
30	2.85	.....	3.32	5.18	5.15	3.70	2.55	2.02	.....
31	2.82	.....	3.50	.....	5.17	.....	2.60	1.95	.....

NOTE.—Effect of ice conditions not known. As evidenced by the measurements made in January and February, 1908, and December, 1907, it must have been slight.

Rating table for Red Cedar River at Menominee, Wis., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	100	1.80	491	3.10	1,317	4.80	3,360
0.60	124	1.90	531	3.20	1,411	5.00	3,640
0.70	149	2.00	574	3.30	1,509	5.20	3,925
0.80	175	2.10	621	3.40	1,611	5.40	4,215
0.90	202	2.20	671	3.50	1,717	5.60	4,510
1.00	230	2.30	725	3.60	1,825	5.80	4,810
1.10	258	2.40	783	3.70	1,935	6.00	5,110
1.20	287	2.50	845	3.80	2,047	6.20	5,420
1.30	318	2.60	912	3.90	2,162	6.40	5,730
1.40	350	2.70	984	4.00	2,280	6.60	6,040
1.50	383	2.80	1,060	4.20	2,535	6.80	6,360
1.60	417	2.90	1,141	4.40	2,800		
1.70	453	3.00	1,227	4.60	3,080		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 12 discharge measurements made during 1907 and 1908 and is fairly well defined between gage heights 2.0 feet and 6.0 feet.

Monthly discharge of Red Cedar River at Menominee, Wis., for 1907 and 1908.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
1907.				
June 17–30	1,260	845	1,070	B.
July	5,050	1,080	1,870	B.
August	2,830	948	1,250	B.
September	6,120	948	1,840	B.
October	2,070	646	1,270	B.
November	1,560	100	1,040	B.
December	1,300	258	923	B.
1908.				
January	1,270	646	942	C.
February	2,100	878	1,200	C.
March	3,570	698	1,570	B.
April	5,040	1,210	2,160	B.
May	3,880	845	1,940	B.
June	3,850	1,140	1,940	B.
July	1,240	598	884	B.
August	845	552	713	B.

NOTE.—Open-channel rating applied throughout the winter periods; effect from ice probably small.

BLACK RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Black River lies west of the central part of the State of Wisconsin. The river rises in the northeastern part of Taylor County, flows in a generally southwesterly direction, and joins the Mississippi at La Crosse. The drainage basin is long and narrow and the tributaries are small. The more important ones are Poplar River and East Fork of Black River, both of which are tributary from the east. The total length of the river is about 145 miles; the total drainage area is about 2,272 square miles.

The basin is about 120 miles long and has an average width of 20 miles. All that portion of the river north of Black River Falls is in the crystalline rock. Through a large portion of this stretch the river has worn deeply into the rock, and the banks rise 40 to 60 feet above the river. In places the rock is covered with glacial drift. Below Black River Falls the river flows into a sandstone region; its valley is wide and the banks are usually low. The surface of the basin is level or rolling. The soil in the upper part of the basin is sandy, but a heavier clay soil is found in some places. This section was at one time covered with pine. In the lower part of the basin the soil is less sandy, as it contains more clay.

The elevation of the source of the river is about 1,400 feet; at Neillsville the elevation is 990 feet; at the mouth of the river the elevation is 628 feet.

The timber on this drainage basin has been about all cut off. The river is no longer used for running logs. The country is well settled.

The mean annual rainfall is about 32 inches. The winter conditions are severe. The snowfall is heavy, and ice forms from 1 to 2 feet in thickness and lasts about three months.

Storage possibilities have not been investigated. There are but few lakes in the drainage basin, and some of these may produce suitable reservoirs, but the basin is so well settled that the building of storage reservoirs would be prohibited by the cost of the land that would be flooded.

Conditions are not favorable for the development of water power, for the drainage area decreases rapidly as the river is ascended. The porous nature of the soil, however, compensates in a measure for the smallness of the drainage area, and power sites of considerable head, favorably located for the building of dams, are numerous. Many of these will undoubtedly be developed. Most of the valuable sites are above Black River Falls. (See Pl. III, *B*.)

The following gaging stations have been maintained in this drainage basin:

Black River at Neillsville, Wis., 1905–1908.
Black River at Melrose, Wis., 1902–3.

BLACK RIVER SURVEY.

In order to point out the power possibilities along Black River, a survey was made during 1906 from Black River Falls to Wisconsin Central Railway crossing. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets and may be had upon application to the Director of the Geological Survey.

BLACK RIVER AT NEILLSVILLE, WIS.

This station, which is located at the lower highway bridge across Black River, about 700 feet below the Chicago, St. Paul, Minneapolis and Omaha Railroad bridge at Neillsville, Wis., was established April 7, 1905, to obtain data for use in studying water power, water supply and pollution problems.

The winter conditions are severe in this vicinity; ice forms to a thickness of 1 to 2 feet and modifies the relation between discharge and gage heights.

The datum of the gage has remained unchanged. The records are reliable and accurate.

Information in regard to this station prior to 1908 is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Black River at Neillsville, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec. ft.*
April 3	A. H. Horton	184	772	6.52	2,340
May 3	do	139	346	4.14	537
June 14	G. A. Gray	147	257	3.39	334
July 13	do	142	226	3.52	255
August 15	do	116	108	2.70	66
Do	do	116	108	2.75	67
September 18	do	121	140	3.00	107
Do	do	121	140	2.97	98
1908.					
July 20	G. A. Gray	129	218	3.50	247
September 15	do	100	78	2.10	37

Daily gage height, in feet, of Black River at Neillsville, Wis., for 1907 and 1908.

[A. Bissell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				7.7	4.6	3.7	3.3	2.5	2.5	3.2	2.6	2.7
2				6.9	4.5	3.4	3.5	2.4	2.4	3.1	2.6	2.8
3				6.6	4.3	3.2	3.4	2.3	2.4	3.1	2.7	2.8
4				6.9	4.1	3.2	3.6	2.3	2.4	3.1	2.7	2.7
5				6.7	4.0	3.1	6.9	2.4	3.2	3.1	3.0	3.0
6				6.4	3.8	3.0	10.15	2.4	2.6	3.2	3.0	2.8
7				6.5	3.8	3.0	4.1	2.4	2.5	3.3	2.9	2.7
8				5.9	3.6	2.9	5.1	2.4	2.5	3.1	2.7	2.8
9				5.7	3.6	2.9	4.5	2.4	2.3	3.1	2.9	2.9
10				5.8	3.5	2.8	4.0	2.4	2.7	3.0	2.9	2.7
11				5.6	3.5	3.0	3.6	2.6	2.3	3.1	2.8	2.8
12				5.6	3.4	3.1	3.3	2.5	2.2	3.0	2.8	2.9
13				5.4	3.4	3.4	3.1	2.4	2.2	3.0	2.6	2.8
14				5.0	3.6	3.5	3.3	2.4	2.4	2.9	2.5	2.7
15				4.8	5.2	3.2	3.2	2.4	2.3	3.4	2.7	2.7
16				4.7	5.9	3.0	3.2	2.5	2.6	2.9	2.6	2.5
17				4.6	5.7	3.0	3.1	2.4	2.5	2.8	2.7	3.0
18				4.4	5.3	3.0	3.0	2.2	2.6	2.8	2.7	2.5
19				4.4	4.7	3.0	3.0	4.3	6.5	2.8	2.6	2.7
20				4.2	4.3	3.0	3.0	3.6	7.0	2.7	2.6	2.7
21				4.1	4.0	3.1	3.0	3.2	6.4	2.5	2.7	2.6
22				4.0	5.6	4.0	3.3	3.2	5.8	2.5	2.8	.....
23				9.2	3.9	5.2	3.9	3.0	3.3	5.3	2.5	2.7	2.6
24				10.1	4.0	4.8	3.9	2.8	2.9	4.8	2.5	2.9	.....
25				11.3	4.1	4.5	3.9	2.7	2.7	4.5	2.5	3.0	.....
26				12.4	4.3	5.0	3.5	2.7	2.7	4.0	2.5	3.0	.....
27				12.4	4.2	4.8	3.2	2.6	2.7	3.8	2.6	2.9	3.1
28				11.0	4.2	4.4	3.0	2.5	2.6	3.6	2.6	2.9	.....
29				11.8	4.6	4.2	2.9	2.9	2.5	3.4	2.5	2.9	.....
30				10.5	4.7	3.8	3.1	2.5	2.5	3.3	2.6	2.7	3.2
31				9.1	.....	3.6	.....	2.4	2.5	.....	2.6	.....	.....
1908.[b]												
1				5.2	6.6	8.5	3.8	3.0	2.4	3.2	3.2	3.4
2			4.6	5.2	6.0	6.8	4.1	2.9	2.3	3.0	3.1	3.4
3	3.3	3.7	.....	5.1	5.4	5.7	3.6	2.9	2.3	3.0	3.0	3.5
4				4.9	5.0	4.8	3.6	2.8	2.3	2.9	3.0	3.5
5				5.4	4.7	4.4	4.0	2.7	2.2	2.8	2.9	3.5
6	3.2	.....	4.8	6.1	4.5	4.0	8.6	2.4	2.2	2.8	2.9	3.6
7	.....	3.7	.....	6.3	4.2	4.2	9.9	2.4	2.1	2.7	2.8	3.8
8				6.2	4.1	8.4	8.5	2.4	2.1	2.7	2.8	3.7
9			4.8	6.3	3.9	8.2	7.1	2.5	2.1	2.6	2.7	3.3
10	3.0	3.9	.....	7.0	3.7	6.9	6.0	2.4	2.1	2.6	2.9	3.2
11				6.7	3.8	6.1	5.2	2.4	2.1	2.5	2.9	3.2
12				6.5	4.7	5.5	4.5	2.4	2.1	2.5	2.7	3.2
13	3.4	.....	7.4	7.1	5.7	7.8	4.0	2.4	2.1	2.4	2.7	3.1
14	.....	4.4	.....	6.6	5.6	7.1	3.7	2.4	2.1	2.4	2.65	3.0
15				6.8	5.9	6.1	3.7	2.4	2.1	2.4	2.8	3.0

[a] Stream frozen January 1 to March 22 and December 22–31, 1907; readings to water surface.
[b] Ice conditions during January, February, March, and after December 18, 1908. Gage readings during the frozen periods taken to water surface.

Daily gage height, in feet, of Black River at Neillsville, Wis., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16	.....	.....	6.7	6.4	5.7	5.1	3.4	2.8	2.1	2.4	2.7	2.9
17	3.4	4.8	.....	6.0	5.3	4.5	3.4	2.7	2.1	2.3	2.9	3.0
18	.....	.....	.....	5.9	5.5	4.2	3.3	2.5	2.1	2.45	2.8	3.0
19	.....	.....	.....	5.9	7.4	4.4	3.3	2.4	2.1	2.4	2.7	2.9
20	3.5	.....	5.2	5.8	6.6	3.9	3.2	2.4	2.1	2.5	2.6	.....
21	.....	4.8	.....	5.5	5.8	3.9	3.2	2.4	2.0	2.55	2.9	.....
22	.....	.....	.....	5.3	9.7	3.6	3.1	2.4	2.0	2.6	2.9	.....
23	.....	.....	6.8	5.1	8.0	5.5	3.1	2.4	2.0	2.6	2.8	.....
24	3.3	4.7	.....	5.2	7.3	5.0	3.1	2.4	2.0	2.7	3.3	.....
25	.....	.....	.....	6.1	7.2	4.5	2.7	2.3	2.0	2.8	3.5	.....
26	.....	.....	.....	6.6	7.2	4.0	2.8	2.3	2.0	3.7	3.8	2.8
27	3.5	.....	7.5	10.8	6.3	3.8	2.8	2.3	2.6	3.8	4.6	.....
28	.....	4.6	.....	10.7	5.9	3.6	2.7	2.3	2.4	3.7	4.5	.....
29	.....	.....	.....	9.1	5.7	3.5	2.7	2.3	2.5	3.65	4.2	.....
30	2.8	.....	.....	7.6	8.6	3.8	2.8	2.3	2.9	3.4	4.0	.....
31	.....	.....	.....	.....	9.9	.....	3.4	2.4	.....	3.3	.....	.....

Rating table for Black River at Neillsville, Wis., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	29	3.30	183	4.60	817	6.80	2,480
2.10	33	3.40	215	4.70	878	7.00	2,660
2.20	38	3.50	251	4.80	941	7.20	2,850
2.30	43	3.60	291	4.90	1,005	7.40	3,050
2.40	49	3.70	334	5.00	1,070	7.60	3,250
2.50	55	3.80	380	5.20	1,204	7.80	3,460
2.60	62	3.90	429	5.40	1,346	8.00	3,680
2.70	70	4.00	480	5.60	1,495	9.00	4,820
2.80	80	4.10	533	5.80	1,645	10.00	6,020
2.90	92	4.20	587	6.00	1,800	11.00	7,300
3.00	108	4.30	642	6.20	1,960	12.00	8,700
3.10	129	4.40	699	6.40	2,130	13.00	10,200
3.20	154	4.50	757	6.60	2,300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905 to 1908 and is well defined between gage heights 2.7 feet and 8 feet.

Monthly discharge of Black River at Neillsville, Wis., for 1907 and 1908.

[Drainage area, 675 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
March 23-31	9,300	4,940	7,200	10.7	3.58	B.
April	3,350	429	1,280	1.90	2.12	A.
May	1,720	215	707	1.05	1.21	A.
June	480	80	183	.271	.30	B.
July	6,200	49	487	.721	.83	B.
August	642	38	91.7	.136	.16	B.
September	2,660	38	473	.701	.78	B.
October	215	55	98.7	.146	.17	B.
November	108	55	79.1	.117	.13	B.
December 1-21	108	55	76.8	.114	.89	B.
1908.						
April	7,040	1,000	2,300	3.41	3.80	A.
May	5,900	334	1,960	2.90	3.34	A.
June	4,230	251	1,410	2.09	2.33	A.
July	5,900	70	847	1.25	1.44	A.
August	108	43	56.3	.083	.10	C.
September	92	29	38.3	.057	.06	D.
October	380	43	112	.166	.19	B.
November	817	62	183	.271	.30	B.
December 1-19	380	92	188	.279	.20	B.

WISCONSIN RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Wisconsin River, except for a few square miles, lies wholly within the State of Wisconsin. The river rises in Lake Vieux Desert, lying directly on the boundary line between upper Michigan and Wisconsin, whence it flows in a southwesterly direction for about 300 miles to the city of Portage near the center of Portage County. At this point it turns westward and empties into the Mississippi River at Prairie du Chien, Wis., about 40 miles from the southern boundary of the State. The important tributaries beginning at the sources are as follows: On the west or right bank of the river, Tomahawk, Rib, Big Eau Pleine, Eau Pleine, Yellow, Lemonweir, Baraboo, Pine, and Kickapoo rivers; on the left bank, Pelican, Prairie, Eau Claire, and Plover rivers.

The total length of the river is about 429 miles; the total drainage area is about 12,280 square miles.

The drainage area is comparatively long and narrow, being about 225 miles long and about 50 miles average width. The river flows, for the most part, in the eastern half of its basin; below Portage it flows within 10 miles of its southern edge. At Portage the divide between Wisconsin River and Fox River is so low that during high water the current in one of the tributaries of the Wisconsin is reversed and flows into the Fox.

Like all the large rivers of the State, the Wisconsin heads in the high drift-covered region. That part of the Wisconsin River basin which lies above Nekoosa, including more than half of the drainage area, is underlain by crystalline rocks, which, by presenting a barrier to erosion, cause numerous rapids that afford excellent sites for water power. Below Nekoosa the crystalline rocks give way to the softer sandstone, the disintegration of which has made the bed of the river one succession of shifting sand bars almost without interruption to its mouth. Where this formation is near the surface in the surrounding country the soil is very light and in places even sterile. North of Nekoosa this sandy belt rapidly narrows, and at Merrill, Wis., about 90 miles above, almost entirely disappears, being replaced by the clayey loams and loamy clays. North of Tomahawk the clays are again replaced by sandy soils containing gravel and by bowlders and glacial drift.

In general, the country is level or undulating. In places decided ridges break the surface, as, for example, the Baraboo ranges of quartzite and the bluffs along the lower river. The northern part of the drainage area is covered with innumerable lakes and swamps, which tend to make the flow of the stream uniform and steady.

According to the United States Engineer Corps, the elevation of Lake Vieux Desert, the source of the river, is about 1,650 feet, the elevation at the mouth is about 604 feet, or a total fall of about 1,050 feet. About 634 feet of this fall occur in the 150 miles between Rhinelander and Nekoosa, an average of over 4 feet to the mile. This descent is concentrated at many places, producing a large number of valuable water powers.

The dense growth of pine which covered the upper part of the drainage basin of Wisconsin River has nearly all been cut off, and a thick growth of brush and second-growth timber has taken its place; large areas have been brought under cultivation. In some places this second growth has been burned over, leaving almost impenetrable thickets of brush and dead timber. The effect of this new growth of brush and timber on the run-off is probably about the same as the pine forests which it has replaced.

The mean annual rainfall on the headwaters of the river is about 31 inches; at the lower part of the basin the rainfall is about 34 inches.

The winter conditions, except in the very lowest part of the basin, are severe. The snowfall is comparatively heavy and stays on the ground for long periods, and the streams are covered with ice from 1 to 2 feet in thickness for three to four months. These severe conditions tend to make the winter season the period of minimum flow, and discharge measurements taken during the ice period are very valuable.

The basin affords numerous opportunities for storage. The United States Engineer Corps located and surveyed eight reservoir sites at the headwaters of Wisconsin River to aid navigation of the Mississippi River. The capacity of these reservoirs is about 20,000,000,000 cubic feet, and it was estimated that a flow of 3,000 cubic feet per second could be maintained for three months. Such a flow would nearly double the low-water flow of the river and its resulting water power. Several of these reservoirs have been constructed by private parties for water-power development. The Wisconsin Valley Improvement Company has been authorized by law to construct, acquire, and maintain a system of reservoirs located on the tributaries of the Wisconsin River north of the south line of township 34, about 6 miles below Tomahawk, for the purpose of producing a uniform flow of water, etc. The law provides that when this company shall have completed reservoirs of a capacity of 2,000,000,000 cubic feet it may collect and receive reasonable tolls from the owner of every improved and operated water power located on the river below such reservoirs. The tolls are to yield not to exceed 6 per cent on the actual investment.

The opportunities for water-power development in this drainage basin are numerous. The development of some of the larger sites is beginning, but many valuable sites on the main river and on the tributaries are still undeveloped. (See Pl. V.)

The stream is used quite extensively for logging, but the greater part of the large timber has been cut off and lumbering is decreasing, although considerable pulp wood is being run on the river. The dams at the water-power sites do not interfere seriously with the small run of logs at the present time.

The following gaging stations have been maintained on the Wisconsin River, viz:

Wisconsin River near Rhinelander, Wis., 1905–1908.
Wisconsin River at Merrill, Wis., 1902–1908.
Wisconsin River near Necedah, Wis., 1902–1908.
Wisconsin River at Muscoda, Wis., 1902–1903.

WISCONSIN RIVER SURVEY.

In order to point out the power possibilities along the Wisconsin River a survey was made during 1906 between Sauk City and Dekorra and between Lewiston Station and Jersey City. From the data collected sheets have been prepared, showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets and may be had upon application to the Director of the Geological Survey.

EAU CLAIRE RIVER SURVEY.

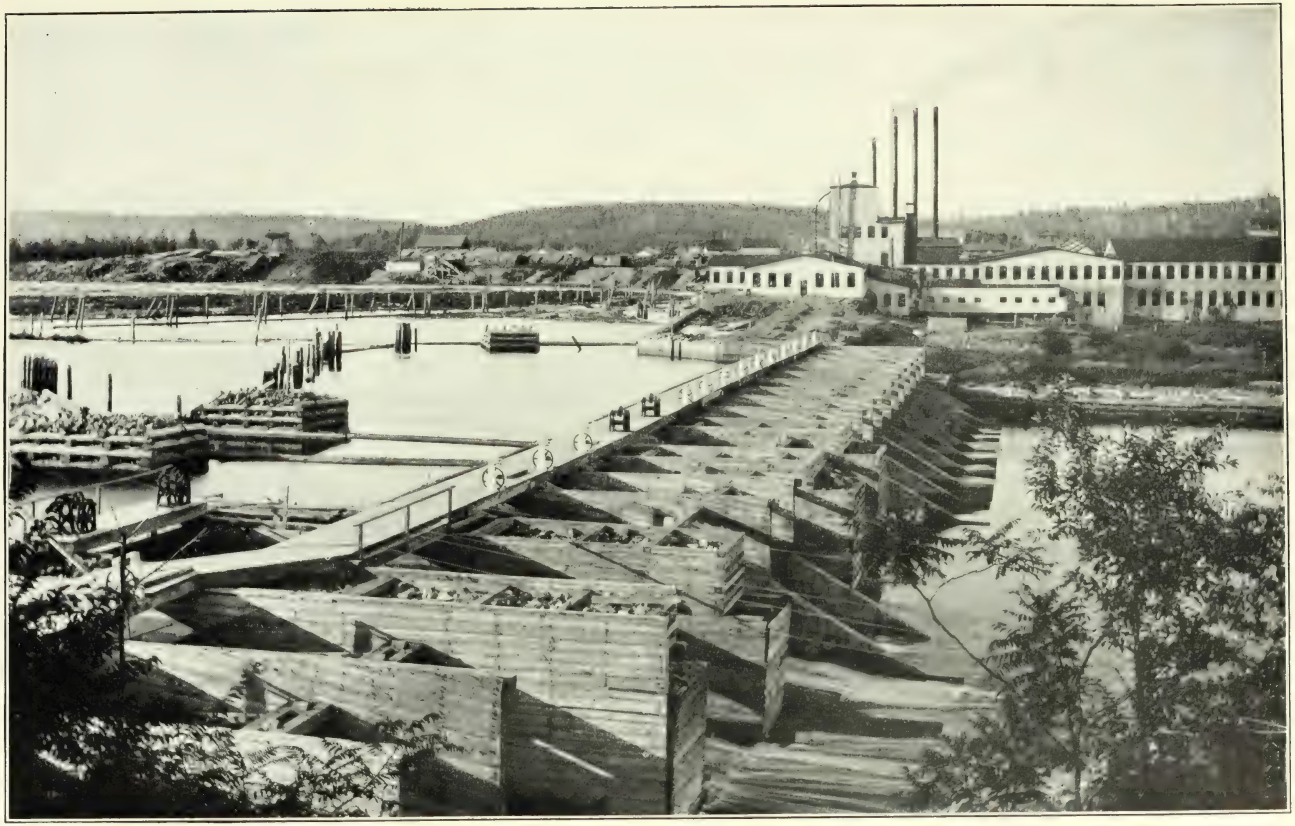
In order to point out the power possibilities along the Eau Claire River, a survey was made during 1906 from the mouth to Johnson. From the data collected sheets have been prepared, showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets and may be had upon application to the Director of the Geological Survey.

WISCONSIN RIVER NEAR RHINELANDER, WIS.

This station, which is located at a highway bridge about 8 miles southwest of Rhinelander, Wis., at Forbes & Wixson's power station, was established December 1, 1905, to obtain data for water power, water-supply, pollution, and storage problems.

Pelican River enters about 8 miles above the station.

The winter conditions in this section are severe, but the operation of the power plant about 400 feet above the bridge prevents the river from freezing at the gaging section, and ice forms only in narrow strips along the shores. The pond above the dam modifies the



DAM ON WISCONSIN RIVER AT BROKAW, WIS.

normal flow, and the total range in gage height is small. The fluctuations of the load on the turbines may also affect discharge measurements.

The datum of the gage has remained unchanged, and aside from the above conditions the records are reliable and accurate.

Information in regard to this station prior to 1908 is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Wisconsin River near Rhinelander, Wis., 1906 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 27	M. S. Brennan	209	473	2.71	1,040
April 17	Horton and Brennan	215	822	4.25	2,580
June 12	M. S. Brennan	216	656	3.60	2,050
1907.					
April 6	A. H. Horton	211	708	3.94	2,390
Do	do	211	712	3.97	2,620
Do	do	211	785	4.29	2,820
October 17	G. A. Gray	196	330	2.55	704
1908.					
July 17	G. A. Gray	200	353	2.30	690

Daily gage height, in feet, of Wisconsin River near Rhinelander, Wis., for 1907 and 1908.

[Charles Hagen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.6	2.8	2.5	4.5	3.2	3.9	3.0	2.8	1.4	2.5	2.1	1.5
2	2.5	2.3	2.4	4.3	4.0	4.1	3.1	2.3	2.8	2.7	2.7	2.1
3	2.4	2.5	2.4	4.8	3.4	3.5	3.1	2.1	2.2	2.3	1.4	2.1
4	2.4	2.5	2.5	4.4	3.3	2.9	3.0	(a)	2.2	3.0	2.4	2.1
5	2.45	2.8	2.5	4.0	3.6	3.7	2.9	2.1	2.2	2.8	2.7	2.1
6	2.4	2.4	2.3	4.4	3.3	3.1	3.1	2.6	2.2	1.6	2.7	2.2
7	2.2	2.5	2.5	4.3	4.0	3.5	3.3	2.1	2.2	2.7	2.1	2.2
8	2.75	2.5	2.4	3.6	3.3	3.1	2.9	2.1	1.4	2.7	2.1	1.6
9	2.75	2.6	2.4	3.6	3.5	3.8	3.5	2.1	2.0	2.2	2.1	2.1
10	2.7	2.4	2.4	3.4	3.6	3.0	3.1	2.3	1.9	2.7	1.4	2.1
11	2.8	2.5	2.5	3.8	3.5	3.0	3.0	1.4	2.6	2.5	2.6	2.1
12	2.7	2.9	2.4	3.8	4.0	2.9	3.1	2.4	2.0	2.5	2.5	2.2
13	2.5	3.1	2.4	3.7	3.9	3.0	3.7	2.7	2.6	1.3	2.6	2.1
14	2.9	2.5	2.1	4.1	4.2	3.0	3.3	2.1	2.6	2.4	2.1	2.1
15	2.4	3.4	2.4	3.4	4.1	3.0	2.5	2.1	.9	2.7	2.1	1.6
16	2.3	2.9	2.4	3.1	3.5	1.9	2.6	2.2	2.6	2.6	2.0	2.6
17	2.7	2.5	2.5	3.3	4.2	2.6	2.9	2.1	2.8	2.0	1.4	2.1
18	2.7	3.1	2.9	3.1	4.4	2.4	2.9	1.4	3.2	2.5	2.2	2.6
19	2.9	3.1	2.4	3.3	4.6	2.6	3.0	3.0	3.3	2.3	2.1	2.1
20	2.8	2.7	2.4	3.1	4.2	2.6	2.9	2.8	3.6	1.4	2.4	2.6
21	2.3	2.4	2.4	3.3	3.9	2.7	1.9	2.8	3.7	2.5	2.5	2.6
22	2.3	2.5	2.8	3.4	4.4	3.0	2.9	2.7	3.8	2.6	2.1	2.2
23	2.5	2.5	2.9	3.1	4.1	1.4	3.0	2.6	3.7	2.2	1.3	3.0
24	2.8	2.5	2.7	3.4	3.8	3.0	2.9	2.2	3.8	2.1	2.6	2.6
25	2.7	3.1	3.3	3.0	4.1	2.3	2.9	1.4	3.3	2.6	2.1	1.6
26	2.3	2.4	3.3	3.3	4.1	3.0	2.9	2.8	3.1	2.6	2.6	2.4
27	2.5	2.4	3.5	3.4	2.9	3.1	3.2	2.8	3.1	1.4	2.4	2.4
28	2.7	2.9	3.7	3.6	3.7	3.1	1.5	2.0	3.3	2.3	2.4	2.6
29	2.9	.....	4.2	3.5	3.4	3.1	2.6	2.2	1.5	2.2	2.4	2.4
30	2.9	.....	3.7	3.4	3.7	1.9	2.7	2.8	3.2	2.1	2.0	2.6
31	2.2	.....	4.4	.....	3.5	.....	2.6	2.1	.....	2.1	.....	2.4

a Water standing in pools.

Daily gage height, in feet, of Wisconsin River near Rhinelander, Wis., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	2.6	2.4	2.8	2.9	4.1	3.1	2.6	3.2	2.6	3.1	1.0	2.2
2	2.7	1.8	2.5	3.0	4.9	3.2	2.5	2.8	2.6	3.0	2.2	2.0
3	2.6	3.2	2.5	2.9	4.4	3.2	2.4	3.4	2.4	3.3	2.2	2.1
4	2.9	2.3	2.5	2.5	3.5	2.9	1.4	2.8	2.2	1.7	2.2	2.2
5	2.5	2.4	2.4	1.7	3.8	2.9	.9	2.8	2.4	2.7	2.1	2.1
6	2.3	2.5	2.5	2.5	3.7	3.1	2.8	2.6	1.7	2.5	2.1	1.5
7	2.7	2.4	2.4	2.9	3.5	3.2	5.0	2.7	2.2	2.6	2.2	2.3
8	2.6	2.4	2.0	2.9	3.4	3.3	3.2	2.6	2.6	2.3	1.5	2.3
9	2.5	2.7	2.4	2.9	3.4	3.0	2.9	1.6	2.6	2.6	2.0	2.2
10	2.7	2.7	2.7	3.0	3.4	3.3	2.6	2.8	2.4	2.3	2.1	2.3
11	2.8	2.5	2.8	4.0	3.3	3.5	1.9	2.5	2.3	1.8	2.1	2.2
12	2.0	2.7	2.8	2.7	3.4	3.4	1.9	2.7	2.2	2.2	2.1	2.7
13	2.7	2.9	2.5	3.2	3.2	3.3	2.4	2.6	1.6	2.3	2.1	1.6
14	2.2	2.9	2.5	3.2	3.5	3.2	2.4	2.1	2.2	2.2	2.1	2.8
15	2.2	2.7	2.3	3.4	3.3	3.2	2.0	2.7	2.4	2.2	1.6	2.8
16	2.2	2.5	2.6	3.4	3.1	3.3	2.3	1.7	2.2	2.2	1.7	2.3
17	2.2	2.3	2.6	3.4	1.9	3.4	2.3	2.5	2.2	2.2	1.9	2.8
18	2.2	3.1	2.5	3.2	3.4	3.1	2.5	2.7	2.1	1.7	1.8	2.8
19	1.6	2.2	2.6	3.9	3.4	3.1	1.8	2.4	2.3	2.2	1.7	2.8
20	2.7	2.6	2.5	3.5	3.2	3.1	3.2	2.4	1.7	1.8	1.9	2.5
21	2.2	2.6	2.6	3.4	3.0	.9	3.6	2.8	2.7	1.8	1.8	2.9
22	2.3	2.8	2.4	3.4	3.3	3.3	3.2	2.3	2.2	1.8	1.6	2.7
23	2.2	2.4	2.7	3.4	2.9	3.0	3.8	1.6	2.2	1.9	1.8	2.4
24	2.4	2.9	2.6	3.5	2.7	3.0	3.3	2.8	2.2	1.8	2.7	2.6
25	2.3	2.3	2.6	3.5	3.3	3.2	3.3	2.7	2.2	1.4	2.7	2.4
26	1.8	2.3	2.6	3.0	3.3	2.9	2.1	2.8	2.3	1.9	2.2	2.6
27	2.1	2.4	2.6	3.7	3.7	3.1	3.3	2.8	1.7	2.2	2.7	2.5
28	2.3	2.3	3.0	4.7	3.1	1.6	2.8	2.4	3.5	2.0	2.3	3.0
29	2.3	2.4	2.2	3.7	3.4	3.0	2.1	2.6	2.9	2.0	1.0	2.3
30	2.4	.....	2.9	3.9	3.3	2.7	2.9	1.6	3.1	2.0	2.3	2.8
31	2.4	.....	2.5	.....	3.1	.....	3.0	2.8	.....	2.0	.....	2.5

Rating table for Wisconsin River near Rhinelander, Wis., 1905 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	0	1.90	324	2.90	1,205	3.90	2,355
1.00	15	2.00	384	3.00	1,320	4.00	2,470
1.10	31	2.10	452	3.10	1,435	4.20	2,700
1.20	52	2.20	526	3.20	1,550	4.40	2,945
1.30	77	2.30	606	3.30	1,665	4.60	3,200
1.40	106	2.40	690	3.40	1,780	4.80	3,460
1.50	140	2.50	775	3.50	1,895	5.00	3,720
1.60	179	2.60	870	3.60	2,010		
1.70	223	2.70	980	3.70	2,125		
1.80	270	2.80	1,090	3.80	2,240		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during 1906–1908 and is well defined between gage heights 2.5 and 4.5 feet.

Monthly discharge of Wisconsin River near Rhinelander, Wis., 1905 to 1908.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
1905.				
December	1,660	566	1,210	B.
1906.[a]				
January	1,320	775	1,080	B.
February	1,550	452	999	B.
March	1,320	606	1,020	B.
April	3,330	1,090	2,120	B.
May	2,700	270	1,660	B.
June	2,940	690	1,730	B.
July	2,580	384	1,180	B.
August	2,010	106	1,150	B.
September	1,660	223	826	B.
October	1,380	270	1,040	B.
November	1,440	77	812	B.
December	1,320	452	899	B.
The year	3,330	77	1,210	
1907.				
January	1,200	526	870	B.
February	1,780	606	963	B.
March	2,940	452	1,080	B.
April	3,460	1,320	2,070	B.
May	3,200	1,200	2,230	B.
June	2,580	106	1,300	B.
July	2,120	775	1,240	B.
August	1,320	0	639	C.
September	2,240	0	1,050	B.
October	1,320	77	676	C.
November	980	77	573	C.
December	1,320	140	578	C.
The year	3,460	0	1,110	
1908.				
February	1,200	179	691	C.
March	1,550	270	839	B.
April	1,320	384	837	B.
May	3,330	223	1,620	B.
June	3,590	324	1,770	B.
July	1,900	0	1,390	B.
August	2,240	0	968	B.
September	1,780	179	870	B.
October	1,900	179	671	C.
November	1,660	106	564	C.
December	980	15	425	C.
The year	1,320	140	749	B.
	3,330	0	950	

[a] Because of a constant error in gage readings, 1906 gage heights after October 17 as published in Water-Supply Paper 207 have been reduced 0.1 foot before the application of the rating table.

WISCONSIN RIVER AT MERRILL, WIS.

This station, which is located at a highway bridge at the east end of Merrill, Wis., was established November 17, 1902, to obtain data for water-power, water-supply, pollution, and storage problems. The bridge is about 1,000 feet below the dam. Prairie River enters from the east about one-half mile above the station. The flow is somewhat modified by the dam and power plants above the station.

The current is so swift that ice does not form across the section, and there is open water at the gage the year round, but winter conditions are severe, and during the ice period the relation between gage height and discharge is affected by backwater. The stream is

used considerably for log running, and jams below the measuring section may affect the gage heights for short periods.

The datum of the gage has remained unchanged; the records are reliable and accurate except as conditions above may affect the readings.

Information in regard to this station is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Wisconsin River at Merrill, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4	A. H. Horton	328	2,420	8.47	11,900
May 3	do	257	1,420	7.26	5,470
June 13	G. A. Gray	324	1,340	5.64	3,070
July 12	do	316	1,180	5.33	2,460
August 14	do	292	924	4.62	1,570
September 17	do	293	1,020	5.00	1,880
1908.					
July 18	G. A. Gray	295	935	4.70	1,650

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1907 and 1908.

[A. F. Lueck, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	4.9	5.15	5.2	.....	6.95	5.8	5.8	4.8	4.1	5.3	5.25	4.4
2	5.15	5.0	5.2	.....	6.85	5.4	5.35	4.95	3.5	5.55	5.2	4.35
3	5.0	5.2	5.3	.....	7.3	5.65	5.95	4.75	3.8	5.5	5.05	3.9
4	4.85	5.1	5.45	8.6	7.05	5.2	5.55	4.3	4.05	5.75	3.7	4.4
5	4.8	5.2	5.75	8.5	7.35	5.8	5.6	4.65	4.5	5.45	4.7	4.35
6	4.95	5.15	5.25	8.55	7.1	5.95	5.9	4.6	4.15	5.15	4.9	5.05
7	4.95	5.05	5.2	8.1	7.25	5.75	5.2	4.75	4.65	4.55	4.9	4.6
8	5.0	5.05	5.1	7.9	8.3	5.7	5.6	4.3	4.4	5.15	4.85	4.75
9	5.15	5.2	4.9	7.2	6.95	5.55	5.9	3.8	4.25	5.5	5.15	4.8
10	5.25	4.95	5.4	7.1	6.5	5.2	5.8	4.45	3.3	5.4	3.55	4.4
11	4.9	5.0	5.25	.....	6.8	5.5	5.7	5.55	4.25	5.2	3.85	4.3
12	5.25	5.1	5.05	.....	6.9	5.4	5.5	4.55	4.45	5.3	4.75	4.35
13	5.15	5.25	5.25	.....	6.55	5.45	5.35	4.85	4.85	5.35	3.05	3.85
14	5.05	5.2	5.1	.....	7.65	6.2	5.8	4.3	4.6	4.35	4.2	4.7
15	5.0	4.95	4.75	.....	8.05	5.8	5.3	4.25	4.2	4.75	4.3	4.7
16	5.6	5.3	4.7	.....	8.3	5.85	5.4	4.4	4.8	5.2	4.3	4.55
17	5.1	4.9	4.9	.....	8.35	5.1	5.45	4.3	4.95	5.1	4.55	4.25
18	5.15	5.0	4.75	5.95	8.05	4.7	5.65	4.1	5.1	4.95	4.7	4.3
19	5.25	5.0	5.25	6.2	7.95	4.9	5.5	3.8	8.55	5.25	4.35	4.5
20	5.1	5.05	5.15	6.45	7.5	5.4	5.8	3.95	9.2	4.95	4.9	4.3
21	5.05	5.35	5.4	6.2	7.05	5.4	5.5	4.4	9.1	4.45	5.05	4.7
22	5.0	5.35	5.15	6.9	7.0	5.35	5.1	4.65	8.9	4.55	4.4	4.45
23	5.5	5.1	5.15	7.1	7.0	5.35	5.5	5.0	7.6	4.9	4.35	4.35
24	5.25	5.1	.....	6.9	7.25	5.15	5.4	5.05	7.35	4.85	4.65	4.45
25	5.2	5.1	.....	7.25	7.15	4.9	5.35	5.3	6.95	4.9	4.7	3.95
26	5.3	5.1	.....	6.75	7.2	5.25	5.25	5.15	6.8	4.35	4.3	3.75
27	5.2	5.35	.....	6.2	7.05	5.2	5.2	4.55	6.35	3.85	5.0	4.1
28	5.35	5.05	.....	6.55	6.95	5.6	4.95	4.3	6.0	4.05	4.6	4.95
29	5.05	.....	.....	6.7	6.05	5.15	3.55	4.4	6.0	5.15	4.5	4.85
30	5.2	.....	.....	6.75	6.65	4.9	4.7	4.7	5.6	5.0	4.5	4.55
31	5.25	.....	.....	.....	6.05	.....	4.5	4.55	.....	5.1	.....	4.6

[a] Bridge was being repaired during March and April, 1907.

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	4.55	4.8	4.6	5.15	8.15	6.75	4.8	5.2	4.2	5.6	3.7	4.55
2	4.75	4.65	4.4	4.85	7.85	6.8	5.6	4.95	3.9	5.2	4.5	4.6
3	4.9	4.3	4.75	5.1	7.8	6.6	5.05	4.45	4.15	5.05	4.55	3.75
4	4.8	4.45	4.7	4.9	7.45	6.35	4.9	4.5	4.35	4.95	4.6	4.55
5	4.45	4.7	4.85	5.15	7.3	6.0	5.75	4.65	4.4	4.95	4.6	4.65
6	4.4	4.55	5.0	5.5	7.2	5.5	6.7	4.6	4.1	4.55	4.45	4.55
7	4.75	4.6	4.9	5.9	6.9	5.65	7.85	5.2	4.3	4.8	4.2	4.5
8	4.65	4.6	4.5	6.05	6.4	6.95	7.6	5.65	5.9	4.75	4.55	4.35
9	4.55	4.8	4.5	6.45	6.45	7.1	7.2	4.85	6.1	4.7	7.35	4.35
10	4.9	4.6	4.35	6.7	6.55	7.15	6.75	4.75	4.55	4.75	5.35	4.55
11	4.45	4.7	4.4	6.65	6.45	6.8	6.1	4.7	3.95	4.6	4.8	4.45
12	4.65	4.85	4.4	6.95	6.15	6.5	5.7	4.3	4.05	4.45	4.4	4.45
13	4.85	4.85	4.75	7.25	5.65	6.7	4.35	3.6	3.95	4.75	4.05	4.25
14	4.65	5.0	4.6	7.55	6.5	6.6	4.85	4.4	4.1	4.6	4.05	4.3
15	4.7	4.85	4.8	8.1	6.3	6.5	4.75	3.6	4.55	4.3	3.95	4.6
16	4.6	4.85	4.85	8.15	6.4	6.9	4.7	4.0	5.05	4.1	4.25	4.9
17	4.7	4.5	4.8	7.6	6.2	6.85	4.55	3.5	3.05	4.25	4.4	4.85
18	4.7	4.8	4.85	7.75	6.5	5.7	4.75	4.1	3.1	4.5	3.75	4.8
19	4.75	4.85	4.75	7.25	6.5	5.8	5.1	4.2	3.2	4.45	2.8	4.85
20	4.75	4.9	4.9	7.15	6.8	5.75	5.3	4.5	3.05	4.6	2.7	4.1
21	4.35	5.2	4.9	7.2	6.3	5.6	5.4	5.05	3.1	4.6	3.85	4.75
22	4.5	4.6	4.8	7.2	7.0	5.25	5.65	5.15	2.85	4.25	3.15	4.85
23	4.55	4.7	5.05	7.25	7.1	5.0	5.75	4.8	2.85	4.6	3.05	4.75
24	4.75	4.5	5.05	7.3	7.35	5.75	5.2	4.3	2.85	4.55	3.15	4.8
25	4.4	4.75	4.95	7.65	7.15	5.9	5.5	2.9	2.9	4.3	3.2	4.55
26	4.2	4.7	5.0	8.2	6.95	5.85	4.65	3.8	2.45	4.3	5.1	4.5
27	4.7	5.05	4.85	8.45	6.9	5.85	4.75	4.5	2.8	4.6	5.05	4.5
28	4.45	4.8	4.85	8.9	6.95	4.9	4.95	4.45	3.15	5.2	5.1	5.05
29	4.55	4.7	4.8	9.25	6.65	4.5	5.15	3.95	5.1	4.85	4.55	5.2
30	4.65	.....	4.85	8.7	6.7	5.35	5.0	4.2	5.7	4.95	4.65	4.95
31	4.7	.....	5.1	.....	6.6	.....	5.25	4.45	.....	4.8	.....	4.6

Rating tables for Wisconsin River at Merrill, Wis.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	200	4.20	937	5.40	2,635	7.20	6,820
3.10	242	4.30	1,027	5.50	2,820	7.40	7,360
3.20	287	4.40	1,122	5.60	3,010	7.60	7,910
3.30	335	4.50	1,225	5.70	3,210	7.80	8,480
3.40	386	4.60	1,340	5.80	3,420	8.00	9,070
3.50	440	4.70	1,465	5.90	3,640	8.20	9,680
3.60	498	4.80	1,600	6.00	3,870	8.40	10,310
3.70	560	4.90	1,750	6.20	4,335	8.60	10,960
3.80	626	5.00	1,915	6.40	4,815	8.80	11,620
3.90	697	5.10	2,090	6.60	5,305	9.00	12,300
4.00	772	5.20	2,270	6.80	5,795	10.00	15,800
4.10	852	5.30	2,450	7.00	6,300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1907. On account of repairs to the bridge, piers, and abutments, and log jams above and below the section, the above table may be 20 per cent in error for low gage heights and about 10 per cent for high gage heights.

FOR 1908.

2.40	80	3.20	340	4.00	850	4.80	1,730
2.50	100	3.30	390	4.10	940	4.90	1,870
2.60	120	3.40	440	4.20	1,030	5.00	2,010
2.70	150	3.50	500	4.30	1,130	5.10	2,160
2.80	180	3.60	560	4.40	1,240	5.20	2,310
2.90	210	3.70	630	4.50	1,350	5.30	2,470
3.00	250	3.80	700	4.60	1,470	5.40	2,640
3.10	290	3.90	770	4.70	1,600	5.50	2,820

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905 to 1908, and is fairly well defined between gage heights 4.5 feet and 8.5 feet. Above gage height 5.5 feet it is the same as the 1907 table.

Monthly discharge of Wisconsin River at Merrill, Wis., for 1907 and 1908.

[Drainage area, 2,630 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	3,010	1,600	2,140	0.814	0.94	B.
February	2,540	1,830	2,130	.810	.84	B.
March	6,600	1,460	2,690	1.02	1.18	B.
April	11,000	3,760	6,390	2.43	2.71	B.
May	10,200	3,980	6,880	2.62	3.02	B.
June	4,340	1,460	2,700	1.03	1.15	B.
July	3,760	469	2,690	1.02	1.18	B.
August	2,920	626	1,370	.521	.60	C.
September	13,000	335	3,710	1.41	1.57	B.
October	3,320	662	2,000	.760	.88	B.
November	2,360	221	1,370	.521	.58	C.
December	2,000	593	1,200	.456	.53	C.
The year	13,000	221	2,940	1.12	15.18	
1908.						
January	1,870	1,030	1,510	.574	.66	B.
February	2,310	1,130	1,650	.627	.68	B.
March	2,160	1,180	1,700	.646	.74	B.
April	13,200	1,800	6,630	2.52	2.81	B.
May	9,520	3,110	5,870	2.23	2.57	B.
June	6,690	1,350	4,220	1.60	1.78	B.
July	8,620	1,180	3,030	1.15	1.33	B.
August	3,110	210	1,370	.521	.60	C.
September	4,100	90	1,050	.399	.45	C.
October	3,010	940	1,600	.608	.70	B.
November	7,220	150	1,340	.510	.57	C.
December	2,310	665	1,490	.567	.65	C.
The year	13,200	90	2,620	.996	13.54	

NOTE.—Discharge estimated by comparison with Rhinelander station for portions of March and April, 1907, when bridge was being repaired.

WISCONSIN RIVER NEAR NECEDAH, WIS.

This station, which is located at the highway bridge about 3 miles east of Necedah, Wis., was established December 2, 1902, to obtain data for studying water power, water supply, and pollution problems.

Big Roche a Cri Creek is tributary from the west about 5 miles below the station. The drainage area above the section is about 5,800 square miles.

The winter conditions are severe. Ice forms from 1 to 2 feet in thickness and lasts for about three months. Part of the river bottom is liable to shift in floods. But few discharge measurements have been made since 1906. The 1906 discharge table should not be used for later years.

The datum of the gage has remained unchanged. The gage heights are reliable and accurate.

Information in regard to this station prior to 1908 is contained in Bulletin XX of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Wisconsin River near Necedah, Wis., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
January 29[a]	G. A. Gray	276	1,550	5.15	1,970
February 19[b]	do	273	1,400	5.70	2,280
July 7	do	309	2,610	6.12	5,570

[a] Ice measurement; average thickness of ice 0.9 foot.
[b] Ice measurement; average thickness of ice 1.1 feet.

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1907 and 1908.

[W. F. Bingham and W. F. Huber, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1				13.3	8.05	6.6	5.2	4.85	4.6	6.3	4.7	4.7
2				13.3	7.75	6.6	5.7	5.1	4.15	6.2	4.7	4.6
3				12.7	7.75	6.4	5.9	4.8	5.05	6.0	4.8	4.3
4				11.75	7.7	6.7	6.4	4.75	4.6	5.75	4.5	4.55
5				10.9	7.7	6.4	6.6	4.8	4.4	5.7	5.15	4.45
6				10.5	7.65	6.0	7.1	4.9	4.6	5.7	4.9	4.6
7				10.7	7.7	6.2	7.4	4.7	4.55	5.45	4.5	4.7
8				10.45	7.3	6.05	7.5	4.6	4.4	5.4	4.5	4.35
9				10.0	7.3	5.95	7.0	4.5	4.0	5.35	4.8	4.2
10				9.6	7.1	5.85	6.7	4.5	4.8	5.2	4.8	4.5
11				9.2	7.4	6.1	6.55	4.8	4.45	5.0	4.4	4.7
12				8.75	7.1	5.9	6.3	4.3	4.45	5.25	5.1	4.5
13			6.4	8.9	7.05	6.0	6.15	4.25	4.4	5.2	4.8	4.7
14			6.55	8.9	7.1	6.1	5.9	4.6	4.6	4.75	4.6	4.4
15			6.4	9.0	6.9	6.0	5.5	4.3	4.55	5.4	4.4	4.4
16			6.35	8.8	7.1	6.05	5.8	4.7	4.4	5.2	4.7	4.5
17			6.4	8.35	7.7	5.65	5.2	4.7	4.7	4.8	4.3	4.5
18			6.6	8.2	8.2	6.05	5.4	4.75	4.6	4.9	4.5	4.6
19			6.85	8.0	8.4	5.55	5.4	4.2	4.7	4.85	4.6	4.6
20			6.4	7.8	8.3	5.65	5.8	4.85	4.75	5.5	4.35	5.8
21			6.2	7.7	8.1	5.5	5.6	4.4	5.4	4.65	4.4	5.7
22			6.3	7.6	7.8	5.9	5.6	4.6	8.6	5.2	4.5	.....
23			6.9	7.5	7.5	5.6	6.0	4.8	9.7	4.85	4.6	.....
24			7.2	7.55	7.25	5.7	5.8	4.8	9.8	4.85	4.8	4.6
25			7.9	7.8	7.4	6.0	5.8	4.8	8.8	4.6	4.6	.....
26			9.05	8.0	7.45	6.15	5.1	4.6	8.6	4.8	4.75	.....
27			10.0	8.0	7.2	6.0	5.4	5.0	7.45	4.8	4.4	.....
28			11.7	8.2	6.9	5.75	5.35	4.9	7.1	4.6	4.7	5.1
29			13.2	8.2	7.2	5.8	4.85	4.9	6.75	5.05	4.7	.....
30			13.5	8.05	7.0	5.7	5.5	4.95	6.5	4.9	4.5	.....
31			13.3	.....	6.9	.....	5.1	4.8	.....	4.6	.....	5.1
1908.[b]												
1		5.2	.....	5.45	12.15	7.63	5.75	5.5	4.55	4.7	5.15	5.65
2			.....	5.65	12.05	8.3	5.6	5.45	4.6	4.7	5.05	4.95
3			5.6	5.95	11.12	9.5	5.3	5.3	4.7	5.2	5.05	5.0
4	5.3	5.2	.....	5.8	10.1	8.63	5.45	5.75	4.75	5.4	5.0	5.0
5			.....	5.7	9.5	7.78	5.45	5.3	4.75	5.2	4.9	5.3
6			.....	5.65	8.95	7.1	5.7	5.35	4.7	5.55	4.75	7.35
7	5.1	.....	5.9	6.2	8.45	7.0	6.15	5.3	5.15	5.0	4.65	.....
8		5.2	.....	6.4	7.98	6.65	6.85	5.05	5.05	5.2	4.9	.....
9			.....	6.8	7.68	6.48	8.95	5.05	4.75	5.05	4.65	6.6
10			5.6	7.0	7.6	7.12	10.15	5.15	4.75	4.85	4.65	.....
11	5.2	5.4	5.5	7.15	7.25	8.08	10.15	5.1	4.35	4.85	4.6	.....
12			5.8	7.4	6.98	8.2	9.25	5.2	5.35	4.7	5.75	.....
13			5.7	8.0	6.98	7.94	8.05	4.65	5.05	5.15	5.4	.....
14	5.2	.....	5.2	8.4	7.1	7.35	7.35	5.0	4.7	4.9	4.8	.....
15		5.5	5.1	8.4	7.52	7.15	6.95	4.95	5.05	4.85	4.85	.....

[a] River was frozen January 1 to March 12, and December 22 to 31, 1907. Gage heights during the frozen period taken to the water surface.
[b] Ice conditions, January 1 to March 11, and December 9 to 31, 1908. Gage readings during the frozen periods taken to water surface.

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16			4.95	8.8	7.6	7.15	6.45	5.0	4.55	4.8	4.6	6.4
17			5.4	8.9	7.62	7.08	6.1	4.9	4.35	4.8	4.4	.....
18	5.2	5.7	5.5	9.15	7.75	6.8	6.0	4.85	4.55	4.7	4.3	.....
19			5.4	8.9	7.88	6.6	5.95	4.85	4.65	4.35	4.6	.....
20			5.4	8.5	7.75	6.45	5.55	4.75	4.95	4.9	4.9	.....
21	5.3	.....	5.3	8.2	7.6	6.18	5.95	4.9	4.45	4.5	4.75	.....
22	.....	5.7	5.1	8.2	7.9	6.1	5.65	4.9	4.9	4.3	4.5	.....
23			4.9	8.1	7.9	6.1	5.85	4.75	4.65	4.7	4.65	6.2
24			5.2	7.8	8.28	6.05	5.9	5.35	4.45	4.6	4.25	.....
25	5.3	5.5	5.2	7.8	9.1	5.9	5.85	4.8	4.6	4.75	4.3	.....
26			5.5	7.7	9.1	5.75	5.85	5.2	4.4	4.6	4.25	.....
27			6.1	8.7	8.65	6.15	5.65	4.85	4.5	4.7	4.3	.....
28	5.1	.....	5.9	9.9	8.24	6.1	5.95	4.75	4.4	4.6	4.55	.....
29	.....	5.7	5.9	10.9	8.28	5.8	5.7	4.75	4.55	4.7	5.5	.....
30			5.7	11.5	8.15	5.8	5.7	4.8	4.45	4.9	5.75	6.0
31			5.8	.....	7.78	.....	5.25	5.1	.....	5.1	.....	.....

WAPSIPINICON RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Wapsipinicon River lies almost entirely in the northwestern part of Iowa. The river rises a few miles north of the Minnesota state line in Mower County, flows southeastward, and joins the Mississippi along the southern boundary of Clinton County, Iowa, about 10 miles below the city of Clinton, Iowa. The length of the river, not following the numerous bends, is about 220 miles, and the total length by stream course is not far from 300 miles. The drainage basin is long and narrow, being approximately 185 miles in length and 14 miles in average width.

The tributaries are all small. The more important are the West, Middle, and East branches, which unite above Tripoli in Bremer County, and Little Wapsipinicon River and Buffalo Creek, which enter from the east.

The basin is underlain by limestones, which have been thinly covered with glacial drift. The surface of the country is a gently undulating prairie, and the valley of the river is narrow with gently sloping sides. Near Anamosa the valley is quite narrow and picturesque; the bed and banks are rocky, the banks rising to a good height and in places running abruptly up into bluffs.

The elevation of the sources of the river is about 1,250 feet; at Independence the elevation is about 900 feet; at Stone City about 780 feet; at the mouth the elevation is 560 feet.

The drainage basin contains no forested areas. The mean annual rainfall is about 32 inches. The winters are severe, snowfall is heavy, and ice forms from 1 to 2 feet in thickness and lasts about three months.

Storage possibilities have not been investigated, but the topography of the basin is not favorable and the high value of the land for farming would undoubtedly prohibit the construction of reservoirs.

A number of fair power sites are found along the river, some of which have been developed. Conditions are favorable for building dams, as the banks are as a rule firm, and rock forms the river bed in many places. The geological formation tends to keep the flow of the river fairly uniform and steady, as the glacial drift is thin, and the rainfall reaches the river through springs at the rock outcrops.

One gaging station has been maintained in this drainage basin:

Wapsipinicon River at Stone City, Iowa, 1903 to 1908.

WAPSIPINICON RIVER AT STONE CITY, IOWA.

This station is located at Stone City, Iowa, at the highway bridge, a short distance above the Chicago, Milwaukee, and St. Paul Railroad bridge. It was established August 19, 1903, to obtain data for use in studying water power, water supply, and pollution problems.

Buffalo Creek is tributary from the east about 4 miles below the station.

The winter conditions are severe, ice forming from 1 to 2 feet in thickness and lasting about three months.

The records at this station are furnished by Frank Dearborn.

December 4, 1906, the gage datum was changed by an unknown amount, due to repairs made on the bridge.

Gage-height and monthly-discharge tables are withheld pending further investigation.

ROCK RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Rock River lies in the southeastern part of Wisconsin and in the northwestern part of Illinois. The river rises in the southeastern part of Fond du Lac County in Wisconsin, flows in a slight southwesterly direction across the Illinois state line, and at Rockford, Ill., turns more to the southwest and joins Mississippi River about 6 miles below the city of Rock Island, Ill. The total length of the river is about 286 miles. The total drainage area is about 11,000 square miles, of which 5,650 square miles is in Wisconsin and about 5,350 square miles in Illinois.

The more important tributaries beginning at the source of Rock River are East Branch of Rock River, Oconomowoc, Bark, Turtle Creek, Kiskaukee, Kyte, and Green rivers on the left or east bank; and West Branch of Rock River, Crawfish, Catfish, and Pecatonica rivers, and Rock Creek on the right or west bank.

The drainage basin is irregular in shape, being about 175 miles in length, and about 85 miles in greatest width. In the upper part of its course the river flows rather toward the eastern side of the basin, at the Illinois state line it approaches the center, and in its lower course it flows decidedly near the western boundary. The rocks underlying this basin are limestones and shales, which have been in large part covered by the drift and morainic débris of glacial times, and the soils vary with the geologic formations on which they rest.

The topography in the Illinois portion of the drainage area is an undulating, semiprairie region; in Wisconsin the surface is moderately hilly, elevations ranging from 750 feet where the river enters the State of Illinois to 1,100 feet on the crests of the Kettle Range. The rise from the interior of the valley is gradual, and few of the hill tops are more than 100 feet above the intervening valleys. The low, uneven topography has led to the formation of an intricate tributary system with numerous spring-fed lakes. These lakes occur chiefly in an eastern and western group, the eastern comprising about 20 lakes with an aggregate area of 11 square miles, and the western including 5 lakes with a total area of 13 square miles. The elevation of the source of the river is approximately 1,000 feet above sea level; at Horicon the elevation is 858 feet; at the state line it is 731 feet, and at the mouth of the river 540 feet. The average slope is a little over 1 foot per mile.

The forested area, according to L. S. Smith, of Madison, Wis., is about 30 per cent in that part of the drainage area in Wisconsin. The forested area in Illinois is probably less than in Wisconsin, as the State has been longer settled.

The mean annual rainfall is about 35 inches. The winters in the northern part of this drainage area are comparatively severe, snowfall is heavy, and ice forms a foot or more in thickness on the streams. In the lower part of the drainage basin the winters are somewhat milder.

The basin affords good opportunities for storage, but the value of the land that would be flooded by reservoirs prohibits their construction. Lake Koshkoning, an expansion of Rock River, 23 square miles in extent, is the only body of water now controlled in the interests of manufacturing.

Although the average slope of Rock River is small, sites for water power are numerous, as in general good foundations for dams may be found. A great many of the power sites are fully or partly developed, but there are still undeveloped power sites on the main stream and its tributaries. The power sites on the tributaries, with few exceptions, have small fall, and many developed sites have been abandoned because of the greater value of the submerged land for farms.

The following gaging stations have been maintained in this drainage basin:

Rock River above mouth of Pecatonica River at Rockton, Ill., 1903.
Rock River below mouth of Pecatonica River at Rockton, Ill., 1903–1908.
Rock River near Nelson, Ill., 1906.
Rock River at Sterling, Ill., 1905–6.
Catfish River at Madison, Wis., 1902–3.
Lake Mendota at Madison, Wis., 1902–3.

ROCK RIVER AT ROCKTON, ILL.

This station, which is located at the highway bridge at Rockton, Ill., was established May 13, 1903, to obtain data for studying water power, water supply, and pollution problems.

Pecatonica River is tributary from the west about three-fourths of a mile above the station. A dam and power plant above the station may modify the flow somewhat during periods of low water. The winters in this vicinity are comparatively mild; ice forms on the river, but open places generally exist at the section. Ice jams are frequent below the station and cause backwater at the gage.

On October 1, 1906, the gage datum was changed by an unknown amount, which approximates about 1 foot.

The monthly discharges for October, November, and December, 1906, were determined from a rating curve applicable to gage heights based on the original datum, and hence are considerably in error. When a new rating curve is developed these will be revised.

Discharge measurements of Rock River at Rockton, Ill., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.[a]	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 30	A. H. Horton	498	1,520	3.23	5,110
Do	do	517	1,610	3.33	5,240
1908.					
February 5	G. A. Gray	508	1,100	2.85	[b] 2,000
February 21	do	427	2,940	7.37	[c] 8,520
April 3	do	512	2,320	4.90	7,860
April 11	do	500	1,910	4.12	6,430

[a] New gage datum.
[b] Ice conditions; average thickness of ice, 0.8 foot.
[c] Ice gorge below gage.

Daily gage height, in feet, of Rock River at Rockton, Ill., for 1907 and 1908.

[O. T. Bartholemew, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	4.2	.....	2.7	6.3	3.5	3.0	2.2	3.2	2.1	5.1	1.95	2.0
2	3.7	.....	2.6	6.0	3.5	2.9	2.15	3.0	2.05	5.15	1.85	1.9
3	3.6	.....	2.5	5.1	3.25	2.7	2.1	2.85	2.1	4.65	1.75	1.75
4	4.4	.....	2.5	4.8	3.35	2.55	2.0	2.8	2.0	4.2	1.85	1.8
5	4.25	.....	2.5	4.75	3.0	3.1	3.6	2.8	1.9	4.05	2.0	1.85
6	4.05	.....	2.65	4.65	2.9	3.15	3.4	2.6	1.8	3.85	1.85	1.95
7	4.05	.....	2.5	4.6	2.8	3.7	3.2	2.5	1.75	3.5	1.75	1.7
8	4.9	.....	2.4	4.9	2.8	4.1	3.0	2.4	1.7	3.4	1.8	1.75
9	4.3	.....	2.3	5.25	2.8	4.7	3.15	2.55	1.65	3.2	1.75	1.85
10	4.15	.....	2.3	5.3	2.4	4.5	3.1	2.5	1.8	3.0	1.65	1.9
11	3.9	.....	2.3	5.2	2.5	4.2	2.65	2.35	1.7	2.85	1.6	2.0
12	3.5	.....	2.3	4.95	2.3	4.0	4.3	2.2	1.8	2.85	1.7	2.0
13	3.4	.....	2.6	4.7	2.1	4.1	4.2	2.15	1.75	2.8	1.7	1.9
14	2.95	.....	2.5	4.6	1.8	4.0	4.15	2.1	1.65	2.6	1.45	1.7
15	2.95	.....	3.5	4.45	2.1	3.9	3.7	2.0	1.55	2.55	1.7	1.75
16	2.3	.....	3.3	4.3	2.0	3.65	3.25	2.0	1.25	2.6	1.6	1.8
17	2.3	.....	3.2	4.1	2.1	3.45	3.2	2.5	1.45	2.5	1.55	1.75
18	2.3	3.7	3.2	4.1	2.15	3.2	3.0	3.5	2.55	2.45	1.6	1.8
19	7.1	4.0	3.15	4.1	2.0	3.5	2.95	3.2	3.6	2.45	1.55	1.8
20	8.0	4.1	3.15	3.85	1.9	3.2	2.75	3.15	4.55	2.5	1.6	1.7
21	4.7	4.3	3.1	3.8	1.9	3.1	2.6	3.2	5.25	2.3	1.7	1.6
22	5.7	4.4	3.1	3.5	1.9	2.85	3.3	3.2	5.35	2.2	2.0	1.4
23	6.8	5.0	3.15	3.35	2.2	2.85	4.5	3.25	5.35	2.1	2.0	1.65
24	7.5	4.35	3.35	3.4	2.6	2.8	4.8	3.15	4.8	2.0	2.3	1.7
25	7.0	3.9	3.4	3.4	2.8	2.9	5.5	2.8	3.7	2.0	2.3	1.7
26	6.3	3.5	3.35	3.25	3.3	2.95	5.85	2.5	3.15	2.0	2.1	1.75
27	6.45	3.0	3.5	3.0	3.45	2.75	5.8	2.5	2.9	1.9	2.0	1.7
28	6.1	2.9	3.5	3.0	3.6	2.4	5.3	2.45	3.3	2.0	2.0	1.8
29	.....	.....	3.9	3.05	3.3	2.5	5.0	2.25	4.5	1.9	2.1	1.85
30	.....	.....	5.2	3.28	3.2	2.3	3.65	2.25	4.8	1.9	2.1	1.9
31	.....	.....	5.65	.....	3.0	.....	3.4	2.2	.....	1.9	.....	2.0
1908.[b]												
1	1.60	3.60	6.05	5.55	4.80	4.70	2.15	1.48	1.05	1.08	1.20	1.70
2	1.95	4.00	6.00	5.20	4.78	4.48	2.18	1.45	1.15	1.00	1.10	1.35
3	1.80	2.50	5.82	4.90	4.55	4.25	2.30	1.40	1.08	1.00	1.10	1.10
4	1.85	2.95	5.92	4.65	4.55	4.05	2.82	1.38	1.10	.95	1.15	1.40
5	2.10	2.90	5.75	4.40	4.58	3.95	3.35	1.22	1.08	.98	1.12	1.35
6	2.00	.....	7.33	4.48	4.70	3.82	3.18	1.32	1.15	.95	1.12	1.15
7	1.90	2.80	7.50	4.42	4.82	4.05	2.88	1.30	.98	1.00	1.18	1.40
8	1.90	.....	7.60	4.52	5.00	4.92	2.65	1.25	1.10	.98	.95	1.50
9	2.10	.....	7.55	4.45	5.05	4.43	2.42	1.15	1.10	.98	1.05	1.50
10	2.00	.....	7.72	4.32	4.85	4.02	2.30	1.10	1.00	1.12	1.10	1.55
11	1.70	2.40	7.60	4.10	4.75	3.72	2.02	1.12	1.00	1.05	1.08	1.45
12	1.70	.....	7.32	4.50	4.60	3.42	1.90	1.18	1.05	1.05	1.10	1.50
13	2.00	7.20	7.05	3.70	4.85	3.85	2.12	1.22	.95	.95	1.10	1.40
14	1.70	5.51	6.50	3.82	5.02	4.30	2.05	1.32	1.15	1.08	1.02	1.25
15	1.85	5.54	5.35	3.60	5.75	4.15	2.00	1.42	1.00	1.02	1.05	1.35
16	1.80	5.71	5.50	3.65	5.45	3.60	2.05	1.75	1.00	.95	1.05	1.35
17	2.00	6.51	5.35	3.42	5.30	3.30	2.18	1.62	1.12	.95	.90	1.40
18	1.75	6.56	5.30	3.35	5.45	3.10	3.30	1.48	1.05	.95	1.08	1.52
19	1.90	6.81	5.18	3.25	5.95	2.85	3.75	1.40	.98	1.00	1.10	1.75
20	1.65	7.51	4.90	3.28	6.15	2.75	3.90	1.42	.95	1.05	1.08	1.95
21	1.40	7.40	4.65	3.18	5.95	3.00	3.38	1.28	.95	1.12	1.12	1.85
22	1.60	7.00	4.50	3.05	5.80	4.40	2.65	1.18	.95	1.08	1.15	1.75
23	1.50	6.01	4.35	3.00	5.60	4.70	2.18	1.35	.95	1.10	1.28	1.75
24	1.80	4.40	4.20	3.18	5.40	4.78	2.00	1.10	1.00	1.18	1.48	1.65
25	1.85	3.63	4.15	3.00	4.90	4.95	1.88	1.18	.95	1.15	1.68	1.65
26	1.60	5.38	3.92	3.00	4.70	4.65	1.85	1.08	1.00	1.12	1.58	1.85
27	2.00	5.30	4.00	4.08	4.45	3.78	1.80	1.05	.95	1.18	1.68	1.25
28	1.80	5.50	4.70	4.50	4.20	3.00	1.70	1.28	1.02	1.18	1.68	1.35
29	2.55	6.35	5.35	4.82	4.55	2.60	1.50	1.08	1.00	1.22	1.50	1.45
30	2.95	.....	5.55	4.80	4.68	2.25	1.48	1.20	1.00	1.18	1.70	1.45
31	2.40	.....	5.47	.....	4.75	.....	1.52	1.05	.....	1.20	.....	1.55

[a] Stream frozen about January 29 to February 17, 1907.
[b] Ice conditions probably prevailed from about the last of January to the middle of February, 1908.

IOWA RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Iowa River and its tributary, Cedar River, occupies the north central and southeast central part of the State of Iowa, and parts of Freeborn, Dodge, and Mower counties in southern Minnesota. The river rises in the northern part of Hancock County, Iowa, flows southeastward, and joins Mississippi River in the southeastern part of Louisa County. The length of Iowa River is about 270 miles, not following the bends. The total drainage area is about 12,400 square miles. Cedar River, which is called a tributary of the Iowa, although its drainage is much the larger, rises in the southern part of Dodge County, in southern Minnesota, flows southeastward into Iowa, and continues in that direction until it reaches Moscow, in the northern part of Muscatine County, where it makes an abrupt turn to the southwest and joins the Iowa in Louisa County. The river is about 260 miles long, not following the bends. In its upper course it is called Red Cedar River. The drainage area above its mouth is about 7,600 square miles. It is the only important tributary of the Iowa. The principal tributaries of Cedar River are: Little Cedar, Shell Rock, and West Fork of Red Cedar rivers, all of which are tributary above Waterloo.

The drainage basin of Iowa River proper is long and narrow. The river rises in a broad, flat, or slightly undulating drift region, and the first rock exposed in its valley is the limestone that forms the rocky banks of the stream in the southwestern corner of Franklin County; from this point to its confluence with the Cedar, the river crosses a succession of sedimentary rocks. The drift which covers this region is well supplied with springs which help to maintain the flow of the stream. The surface of the surrounding country is a gently undulating prairie.

The drainage basin of Cedar River is underlain throughout its entire course by limestones which are thinly covered with glacial drift. Rock is exposed at many places along the main stream and its tributaries. The valleys of the upper tributaries are narrow, with gently sloping sides; below the mouth of the Shell Rock the valley is broad and shallow, and is separated from the uplands by distinctly defined borders. The surface of the country is a gently undulating prairie, apparently level in some sections. The upper basin is about 50 miles wide, but the lower is much narrower, and at one point below Cedar Rapids it measures only 8 or 9 miles across.

At the headwaters of both Iowa and Cedar rivers are a few lakes, ranging in area from 2 to 10 square miles.

The elevation of the sources of Iowa River is about 1,250 feet above sea level; at Iowa City the elevation is 670 feet; at the mouth of the

Cedar it is 565 feet, and at the junction with the Mississippi the elevation is about 522 feet. The elevation of the sources of Cedar River is about 1,300 feet; at Waterloo about 820 feet; at Cedar Rapids about 725 feet, and at the mouth about 565 feet.

The basin contains no large forested areas. The mean annual rainfall is about 32 inches. The winters are severe, especially in the upper part of the basin. The fall of snow is comparatively heavy, and ice forms to considerable thickness on the streams and lasts for three to four months.

Storage possibilities have not been investigated; it may be possible to make storage reservoirs at the lakes at the headwaters of both Cedar and Iowa rivers, but the overflow damages would undoubtedly prohibit their construction.

Iowa and Cedar rivers are by far the most important streams in Iowa for water power. Power sites of small head are numerous, and a number of them have been developed. Those on Cedar River are more important than those on the Iowa. The numerous rock outcrops furnish good foundations for dams. The flow of the streams sustained is kept up by numerous springs, but during long-continued droughts the flow becomes very low.

The following gaging stations have been maintained in this drainage basin:

Iowa River at Marshalltown, Iowa, 1903.
Iowa River at Iowa City, Iowa, 1903–1906.
Red Cedar River at Janesville, Iowa, 1905–6.
Cedar River at Cedar Rapids, Iowa, 1903–1908.

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

This station, which is located on the First Avenue Bridge at Cedar Rapids, Iowa, was established October 26, 1902, to obtain data for studying water power, water supply, and pollution problems.

The gage is located about one-half mile below the First Avenue Bridge. Discharge measurements previous to 1903 were made from a cable immediately above the gage. There is a large island in the river about 500 feet below the section.

The gage is located where the current is swift and the river rarely freezes clear across, ice forming only along the shores. The relation between gage height and discharge is probably therefore very little affected by ice. A dam and power plant above the station may modify the flow to some extent in low water.

The gage is an inclined timber set on posts in the bank of the river. The elevation of the gage has not been checked for a number of years, but it is thought that the datum has remained unchanged. The records and estimates of the discharge at this station are considered excellent.

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1907 and 1908.

[R. S. Toogood, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	4.15	4.4	4.55	5.05	3.55	3.5	4.15	4.85	4.95	4.0	3.45	3.45
2	4.25	4.55	4.75	5.0	3.6	3.45	4.05	4.6	4.8	4.6	3.45	3.4
3	4.65	4.45	4.8	5.0	3.65	3.55	4.05	4.4	4.55	4.95	3.45	3.3
4	4.7	4.3	5.95	4.85	3.6	3.65	4.4	4.3	4.3	5.15	3.4	3.25
5	4.65	4.25	6.4	4.6	3.55	3.75	4.4	4.25	4.15	4.7	3.4	3.15
6	4.55	4.4	6.55	4.4	3.55	3.85	4.6	4.65	4.05	4.5	3.4	3.3
7	4.7	4.2	5.6	4.3	3.5	4.1	5.05	5.0	3.95	4.2	3.45	3.45
8	4.8	4.15	5.3	4.25	3.5	4.25	4.7	5.1	3.95	4.1	3.4	3.6
9	4.65	4.05	5.0	4.2	3.45	4.4	5.1	4.6	3.9	3.9	3.45	3.55
10	4.45	4.0	4.75	4.15	3.4	4.85	5.4	4.85	3.9	3.85	3.45	3.5
11	4.2	3.9	4.65	4.15	3.35	5.4	5.45	5.0	3.95	3.75	3.4	3.4
12	4.1	3.85	4.5	4.1	3.3	5.3	5.5	4.8	3.9	3.7	3.4	3.25
13	4.3	4.15	4.45	4.05	3.25	5.5	5.5	4.65	3.85	3.7	3.4	3.35
14	4.35	4.8	4.4	3.95	3.3	5.85	5.9	4.3	3.7	3.65	3.35	3.4
15	4.25	4.65	4.5	3.9	3.3	5.95	6.45	4.15	3.65	3.6	3.35	3.45
16	4.1	5.2	4.55	3.85	3.25	5.75	6.6	7.2	3.65	3.6	3.4	3.4
17	3.85	5.35	4.65	3.8	3.2	5.3	7.2	8.15	3.6	3.55	3.35	3.45
18	3.6	5.6	4.65	3.75	3.2	5.25	7.25	6.25	3.65	3.55	3.3	3.35
19	6.1	5.75	4.7	3.65	3.15	5.35	7.8	5.0	3.75	3.5	3.3	3.2
20	6.15	5.8	4.7	3.65	3.15	5.35	8.4	4.55	3.9	3.5	3.3	3.15
21	6.05	5.85	4.7	3.65	3.1	5.05	7.6	4.25	3.9	3.5	3.4	3.1
22	5.1	6.3	4.65	3.6	3.1	4.85	7.0	4.15	4.0	3.5	3.5	3.1
23	4.95	6.6	4.6	3.6	3.55	4.75	6.6	4.4	4.25	3.45	3.55	3.25
24	5.1	6.3	4.65	3.55	3.3	4.55	6.2	4.5	4.1	3.45	3.5	3.35
25	4.95	5.4	4.65	3.55	3.8	4.45	5.85	4.5	3.9	3.4	3.5	3.3
26	4.85	4.95	4.65	3.5	3.8	5.0	5.6	4.35	3.85	3.4	3.45	3.35
27	5.0	4.75	4.6	3.5	3.7	5.15	5.55	4.3	3.8	3.35	3.45	3.35
28	4.75	4.6	4.6	3.5	3.65	4.95	5.6	4.4	3.95	3.35	3.45	3.35
29	4.55	.....	4.65	3.45	3.65	4.55	5.9	4.75	4.35	3.4	3.4	3.3
30	4.5	.....	4.7	3.55	3.6	4.15	5.75	5.35	4.15	3.45	3.4	3.3
31	4.5	.....	4.9	.....	3.5	.....	5.2	5.25	.....	3.4	.....	3.15
1908.[b]												
1	3.05	3.25	4.85	4.1	3.9	7.15	6.05	3.8	3.4	2.95	3.4	3.15
2	3.0	3.2	4.7	3.95	3.95	6.55	5.85	3.8	3.35	2.95	3.35	3.05
3	3.05	3.2	4.55	3.8	3.9	6.15	5.45	3.75	3.35	2.9	3.3	3.05
4	3.15	3.15	4.45	3.75	3.85	5.85	5.3	3.7	3.35	2.9	3.25	3.1
5	3.25	3.25	4.3	3.75	3.8	5.45	5.15	3.7	3.3	2.95	3.25	3.05
6	3.25	3.2	4.25	3.75	3.75	5.25	5.05	3.6	3.3	2.95	3.2	3.1
7	3.2	3.15	4.7	3.75	3.65	5.1	4.8	3.55	3.2	2.9	3.2	3.1
8	3.15	3.15	4.95	3.7	3.6	4.95	4.65	3.55	3.2	2.9	3.2	3.05
9	3.1	3.15	5.2	3.75	3.7	4.8	4.85	3.5	3.2	2.9	3.15	3.05
10	3.05	3.2	6.15	3.7	3.75	4.65	5.15	3.5	3.15	2.95	3.1	3.0
11	3.05	3.25	6.2	3.75	4.1	4.6	5.25	3.5	3.15	2.95	3.1	3.0
12	3.1	4.8	6.05	3.7	4.05	4.6	5.2	3.5	3.1	3.0	3.1	3.0
13	3.05	5.2	5.7	3.75	4.1	4.65	4.95	3.55	3.05	3.0	3.05	3.05
14	3.05	4.7	5.4	3.75	4.2	4.6	4.6	3.5	3.05	2.95	3.1	3.1
15	3.1	4.45	5.25	3.7	4.0	4.5	4.4	3.5	3.0	2.95	3.15	3.05
16	3.15	4.9	5.25	3.65	3.9	4.35	4.35	3.5	3.0	2.95	3.1	3.1
17	3.2	4.7	5.15	3.65	4.1	4.3	4.4	3.45	3.0	3.0	3.1	3.15
18	3.15	4.65	4.85	3.6	4.45	4.25	4.3	3.45	2.95	3.0	3.05	3.15
19	3.1	4.5	4.65	3.6	4.55	4.2	4.3	3.65	2.95	3.0	3.0	3.25
20	3.15	4.6	4.4	3.6	4.6	4.5	4.85	3.6	2.95	2.95	2.95	3.15
21	3.2	4.55	4.25	3.55	4.5	4.6	5.45	3.6	2.95	2.95	2.95	3.1
22	3.2	4.35	4.1	3.7	4.35	5.2	5.9	3.55	2.9	2.95	2.95	3.1
23	3.15	4.3	4.0	3.85	4.4	5.25	5.55	3.5	2.9	2.95	2.9	3.05
24	3.05	4.25	3.85	3.85	4.8	5.65	4.9	3.45	2.9	3.0	2.95	3.0
25	3.05	5.2	3.95	3.9	5.7	6.65	4.5	3.45	2.9	3.1	3.15	3.0
26	3.15	5.05	3.85	3.8	6.55	8.0	4.3	3.4	2.85	3.2	3.1	3.0
27	3.2	5.0	3.85	3.75	6.85	7.65	4.2	3.35	2.9	3.3	3.1	3.0
28	3.15	4.95	3.8	3.75	7.2	7.45	4.1	3.35	3.05	3.4	3.05	2.95
29	3.2	4.8	3.75	3.85	7.7	7.35	4.0	3.4	3.0	3.45	3.05	2.95
30	3.2	.....	3.75	3.85	8.65	6.35	3.95	3.4	3.0	3.5	3.25	2.9
31	3.25	.....	4.05	.....	8.05	.....	3.9	3.4	.....	3.45	.....	2.9

[a] Ice conditions from January 7 to February 20, 1907.
[b] Ice conditions from January 14 to March 9, and December 2 to 31, 1908.

Rating table for Cedar River at Cedar Rapids, Iowa, for 1906 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	840	4.10	3,475	5.30	7,550	7.00	13,850
3.00	970	4.20	3,800	5.40	7,900	7.20	14,640
3.10	1,110	4.30	4,125	5.50	8,250	7.40	15,430
3.20	1,270	4.40	4,450	5.60	8,600	7.60	16,220
3.30	1,440	4.50	4,775	5.70	8,950	7.80	17,010
3.40	1,625	4.60	5,100	5.80	9,300	8.00	17,800
3.50	1,825	4.70	5,450	5.90	9,650	8.20	18,590
3.60	2,050	4.80	5,800	6.00	10,000	8.40	19,380
3.70	2,300	4.90	6,150	6.20	10,750	8.60	20,170
3.80	2,575	5.00	6,500	6.40	11,510	8.80	20,960
3.90	2,875	5.10	6,850	6.60	12,280		
4.00	3,175	5.20	7,200	6.80	13,060		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 34 discharge measurements made during 1903 to 1906 and is well defined. Above gage height 7 feet the rating curve is a tangent, the difference being 395 per tenth.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for 1907 and 1908.

[Drainage area, 6,320 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	10,600	2,050	5,410	0.856	0.99	A.
February	12,300	2,720	6,130	.970	1.01	A.
March	12,100	4,450	6,040	.956	1.10	A.
April	6,680	1,720	3,280	.519	.58	A.
May	2,580	1,110	1,740	.275	.32	A.
June	9,820	1,720	5,650	.894	1.00	A.
July	19,400	3,320	9,350	1.48	1.71	A.
August	18,400	3,640	6,090	.964	1.11	A.
September	6,320	2,050	3,250	.514	.57	A.
October	7,020	1,530	2,710	.429	.49	A.
November	1,940	1,440	1,650	.261	.29	A.
December	2,050	1,110	1,510	.239	.28	A.
The year	19,400	1,110	4,400	.699	9.45	
1908.						
January	1,360	970	1,170	.185	.21	B.
February	7,200	1,190	3,920	.620	.67	A.
March	10,800	2,440	5,370	.850	.98	A.
April	3,480	1,940	2,460	.389	.43	A.
May	20,400	2,050	6,030	.954	1.10	A.
June	17,800	3,800	8,330	1.32	1.47	A.
July	10,200	2,880	5,940	.940	1.08	A.
August	2,580	1,530	1,910	.302	.35	A.
September	1,620	840	1,100	.174	.19	B.
October	1,820	840	1,050	.166	.19	B.
November	1,620	840	1,150	.182	.20	B.
December	1,360	840	1,050	.166	.19	B.
The year	20,400	840	3.290	.521	7.06	

NOTE.—Open-channel rating applied during the periods of ice conditions; accuracy only very slightly affected thereby.

The above values of accuracy are dependent on the constancy of conditions of flow since the last measurements were made in 1906.

SANGAMON RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Sangamon River lies wholly within the State of Illinois, very nearly in the center of the State. The river rises in the southwestern part of Ford County, flows southwestward to Decatur, in Macon County, thence westward to a point near

Springfield, northwestward to its junction with Salt Creek at the northern boundary line of Menard County, and westward to its junction with Illinois River at the northern boundary of Cass County. Springfield is about 20 miles southwest of the center of the basin, which is roughly a right triangle in shape, with the mouth of the river opposite the vertical. The total drainage area is about 5,180 square miles. The principal tributaries are Salt Creek and South Fork.

The eastern third of the drainage basin is somewhat undulating and elevated, the rest of the basin is a level prairie. The soil is very fertile, rich, black loam, especially adapted for raising corn. There are coal mines in the vicinity of Springfield. The bed and banks of the river are soft and insecure. The slope of the river is small. The elevation of its source is about 700 feet above sea level, and that of its mouth is about 430 feet. The only timber in this drainage basin is in small groves or along the river banks.

The annual rainfall is about 37 inches. The winters are mild. Ice forms to some extent, and during severe winters attains considerable thickness.

Storage possibilities have not been investigated, but are of considerable interest.

The basin contains numerous swamp areas, and is so level and low that very little ground storage is available. High water follows every heavy rain, floods are of frequent occurrence and considerable duration, and as the banks of the river are low large areas are flooded. The drainage of the swamps and the opening up of channels so that flood waters may have an opportunity of returning quickly to the main stream makes the study of flood control and drainage of considerable importance. In some places short sections of the main stream are being straightened in an effort to provide a better channel so that floods will quickly drain off the adjacent land. Such work is of doubtful value, for in a few years at the most the river will return to its former channel or make new channels in order to keep in equilibrium. Any improvement of this nature should take into account the stream as a whole and should be commenced at the lower end.

On account of the low slope, floods, low water, and lack of suitable foundations for dams, opportunities for water power are lacking.

The following gaging stations are being maintained in this drainage basin:

Sangamon River at Monticello, Ill., 1908.
Sangamon River at Decatur, Ill., 1905.
Sangamon River at Riverton, Ill., 1908.
Sangamon River at Springfield, Ill., 1903.
Sangamon River near Chandlerville, Ill., 1908.
South Fork of Sangamon River near Taylorville, Ill., 1908.
Salt Creek near Kenney, Ill., 1908.

SANGAMON RIVER AT MONTICELLO, ILL.

This station, which is located at the Illinois Central bridge, about one-half mile west of the town of Monticello, Ill., was established February 4, 1908, for the purpose of collecting data to be used in studying drainage, water supply, and flood control.

No important tributaries enter near this station. The drainage area above the section is about 544 square miles.

The datum of the gage has not been changed. The records are reliable and accurate; the figures for low-water discharge should be used with caution until verified by more measurements.

The daily and monthly discharge have not yet been determined on account of insufficient data.

Discharge measurements of Sangamon River at Monticello, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	R. J. Taylor	154	1,110	9.25	1,410
May 12	do	366	2,860	13.65	6,830
July 26	do	101	130	2.65	61
December 15	do	67	64	2.05	13

Daily gage height, in feet, of Sangamon River at Monticello, Ill., for 1908.

[Martin Doyle, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		9.9	6.6	10.0	7.3	3.1	2.2	2.0	1.9	2.0	2.2
2		10.0	6.7	9.1	6.8	3.7	2.2	1.9	1.9	2.0	2.2
3		10.5	6.5	8.5	6.4	3.3	2.2	1.9	1.9	2.0	2.2
4	4.2	10.7	6.3	9.6	6.2	3.2	2.1	1.9	1.9	2.0	2.2
5	6.1	10.7	6.2	11.3	6.0	3.1	2.1	1.9	1.8	2.0	2.2
6	8.6	10.7	6.2	11.5	5.6	3.0	2.1	1.8	1.8	2.0	.....
7	9.0	10.7	6.1	12.5	5.4	3.0	2.1	1.8	1.8	2.0	2.1
8	8.3	10.8	6.8	13.5	5.1	2.9	2.1	1.8	1.8	2.0	2.1
9	7.7	10.7	9.1	13.1	5.0	2.9	2.0	1.8	1.8	2.0	2.1
10	6.9	10.2	9.4	12.8	4.9	2.9	2.0	1.8	1.8	2.0	2.0
11	6.3	9.6	8.8	11.8	4.7	2.8	2.0	1.8	1.8	2.0	2.0
12	7.3	9.2	8.2	13.6	4.5	2.8	2.0	1.8	1.8	2.0	2.0
13	8.6	8.8	7.4	14.6	4.3	2.7	2.1	1.8	1.8	2.0	.....
14	10.2	8.4	7.2	15.2	4.4	2.9	2.3	1.8	1.8	2.0	2.0
15	11.2	8.0	6.9	14.0	4.4	3.1	2.2	1.8	1.8	2.0	2.0
16	11.4	7.4	6.9	12.6	4.2	2.9	2.2	1.8	1.8	2.0	2.0
17	12.0	7.1	7.0	11.7	4.0	2.8	2.2	1.8	1.8	2.0	2.0
18	11.3	7.1	7.0	12.0	3.9	2.7	2.1	1.8	1.8	2.0	2.0
19	10.2	8.0	6.8	11.6	3.8	2.6	2.0	1.8	1.8	2.0	2.0
20	8.2	8.7	6.7	11.5	3.8	2.6	2.0	1.8	1.8	2.0	.....
21	8.0	8.9	6.4	11.5	3.7	2.6	2.0	1.8	1.8	2.0	2.0
22	7.7	8.5	6.0	11.6	3.5	2.6	2.0	1.8	1.9	2.0	2.0
23	7.9	7.9	6.0	10.8	3.5	2.5	1.9	1.8	1.9	2.1	2.0
24	7.4	7.3	8.0	10.1	3.4	2.5	1.9	1.8	1.9	2.1	2.0
25	8.3	6.9	10.1	9.7	3.3	2.6	1.9	1.8	1.9	2.1	2.0
26	10.1	6.6	10.5	9.2	3.2	2.6	1.9	1.8	1.9	2.2	2.0
27	10.6	6.3	11.1	8.7	3.1	2.5	1.9	1.8	1.9	2.2	.....
28	10.5	6.3	11.0	8.2	3.1	2.5	1.9	1.9	2.0	2.1	2.0
29	10.5	6.9	10.8	8.1	3.2	2.4	1.9	1.9	2.0	.....	2.0
30	.....	6.4	10.7	8.0	3.2	2.3	1.9	1.9	2.0	2.3	2.3
31	.....	6.6	.....	7.8	.....	2.3	1.9	.....	2.0	.....	2.4

SANGAMON RIVER AT RIVERTON, ILL.

This station is located at the Wabash Railroad bridge about one-fourth mile west of the depot at Riverton, Ill. It was established February 13, 1908, to obtain data to be used in the study of drainage and flood-control problems.

The South Fork enters 2 or 3 miles above the station. The drainage area above the section is about 2,530 square miles.

The datum of the gage has not been changed. The records are reliable and accurate.

Sufficient data have not been collected to enable determination of the daily and monthly discharge.

Discharge measurements of Sangamon River at Riverton, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 13	R. J. Taylor	218	2,200	16.50	3,760
July 27	do	151	733	8.4	326

Daily gage height, in feet, of Sangamon River at Riverton, Ill., for 1908.

[B. H. Watson, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	22.1	15.9	20.4	16.2	9.5	8.0	7.6	7.0	6.7	7.1
2	.....	21.9	16.0	19.8	15.1	9.4	7.9	7.6	7.0	6.7	7.1
3	.....	21.7	16.1	19.4	14.3	9.2	7.9	7.5	6.9	6.7	7.1
4	.....	21.5	16.0	21.8	13.8	9.0	7.8	7.5	6.9	6.6	7.1
5	.....	21.3	15.8	23.1	13.5	9.0	7.8	7.4	6.9	6.6	7.1
6	.....	21.6	15.7	23.8	13.2	8.9	7.7	7.3	6.9	6.6	7.1
7	.....	21.5	16.0	24.8	12.9	9.7	7.7	7.3	6.9	6.6	7.1
8	.....	21.6	16.4	26.3	12.5	10.6	7.7	7.2	6.9	6.6	7.1
9	.....	22.1	16.7	26.4	12.0	10.5	7.7	7.2	6.9	6.6	7.1
10	.....	22.3	16.9	26.0	11.9	10.0	7.7	7.2	6.9	6.6	7.1
11	.....	22.1	17.1	25.8	11.7	9.5	7.7	7.2	6.9	6.6	7.1
12	.....	21.9	17.1	25.4	11.5	9.3	7.7	7.2	6.9	6.6	7.1
13	16.5	21.7	17.0	24.8	11.4	9.1	7.7	7.2	6.9	6.6	7.1
14	18.0	21.5	16.9	24.3	11.0	8.9	7.7	7.2	6.8	6.6	7.1
15	19.9	21.0	16.4	23.3	10.8	8.7	7.7	7.2	6.8	6.6	7.1
16	20.0	20.7	15.9	23.2	10.6	8.7	7.7	7.2	6.8	6.6	7.1
17	20.9	19.5	15.1	23.4	10.4	8.6	7.7	7.1	6.8	6.7	7.1
18	20.5	17.1	14.5	23.5	10.3	8.6	7.6	7.1	6.8	6.8	7.1
19	20.0	16.5	14.0	23.1	10.2	8.5	7.6	7.0	6.8	6.8	7.1
20	20.4	16.0	13.9	22.6	9.9	8.5	7.6	6.9	6.8	6.8	7.1
21	20.5	15.5	13.4	22.1	9.8	8.5	7.6	6.9	6.7	6.8	7.1
22	20.5	15.1	13.4	22.6	9.6	8.5	7.5	7.0	6.7	6.8	7.1
23	20.1	14.9	13.9	22.4	9.5	8.5	7.4	7.0	6.7	6.9	7.1
24	20.0	14.7	14.9	22.2	9.4	8.6	7.4	7.0	6.7	6.9	7.1
25	20.6	14.4	16.0	22.0	9.3	8.6	7.3	7.0	6.7	7.0	7.1
26	21.7	14.3	18.6	21.9	9.2	8.5	7.3	7.0	6.7	7.0	7.1
27	22.1	14.6	19.7	21.4	9.1	8.5	7.2	7.0	6.7	7.1	7.1
28	22.0	15.0	21.1	20.5	9.0	8.4	7.2	7.0	6.7	7.1	7.1
29	21.8	15.6	20.9	19.7	9.0	8.3	7.2	7.0	6.7	7.1	7.1
30	.....	15.9	20.7	19.0	9.6	8.2	7.1	7.0	6.7	7.1	7.1
31	.....	16.1	.....	17.9	.....	8.1	7.4	.....	6.7	.....	7.1

SANGAMON RIVER NEAR CHANDLERVILLE, ILL.

This station is located at the highway bridge about 1 mile west of the town of Chandlerville, Ill. It was established February 9, 1908, for the purpose of collecting data for use in studying drainage and flood-control problems. It was discontinued December 31, 1908, because it was found that the flood flow could not be measured, as part of the flow passed around the section at high water.

No tributaries enter near the station. The drainage area above the section is about 5,070 square miles.

The low-water fall between this point and Illinois River is about 20 feet; the Illinois rises about 22 feet above low water, and therefore there is liable to be backwater effect at this station from Illinois River.

The gage datum has not been changed. The records are reliable and accurate. Sufficient data were not obtained to enable the determination of the daily and monthly discharge.

Discharge measurements of Sangamon River near Chandlerville, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 30	R. J. Taylor	140	1,380	4.6	1,150
November 7	do	110	872	2.17	368

Daily gage height, in feet, of Sangamon River near Chandlerville, Ill., for 1908.

[Mrs. Frank Long, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		13.5	10.3	13.0	13.0	5.8	4.1	3.0	2.0	2.2	2.2
2		13.5	10.2	12.9	12.7	5.9	4.0	3.3	2.0	2.2	2.2
3		13.3	10.0	12.7	12.2	6.0	3.9	3.3	1.9	2.2	2.2
4		13.25	10.1	12.8	11.5	6.2	3.8	3.0	1.9	2.2	2.2
5		13.3	10.2	13.0	11.0	6.4	3.7	2.9	1.9	2.2	2.2
6		13.2	10.1	13.5	10.6	6.1	3.7	2.8	1.9	2.2	2.2
7		13.2	10.1	14.2	10.2	6.1	3.6	2.5	1.9	2.2	2.2
8		13.2	10.2	14.8	10.0	6.3	3.5	2.5	1.9	2.2	2.2
9	11.3	13.2	10.3	14.9	9.8	6.6	3.5	2.5	1.9	2.2	2.2
10	11.5	13.1	10.6	15.1	9.5	6.9	3.5	2.5	1.9	2.2	2.2
11	11.4	13.0	10.9	15.2	9.1	6.5	3.3	2.5	1.9	2.2	2.2
12	11.25	13.0	11.0	15.5	9.0	6.1	3.2	2.4	1.9	2.2	2.2
13	11.25	13.0	11.1	16.0	8.9	5.8	3.4	2.2	1.9	2.2	2.2
14	11.7	13.0	11.0	16.3	8.9	5.6	3.3	2.2	1.9	2.2	2.2
15	12.0	12.9	11.1	16.5	8.6	5.5	3.2	2.2	1.8	2.2	2.2
16	12.2	12.8	11.0	16.5	8.2	5.5	3.2	2.2	1.8	2.2	2.2
17	12.5	12.6	11.0	16.0	8.0	5.5	3.2	2.2	1.8	2.2	2.2
18	12.9	12.5	11.2	15.2	7.7	5.4	3.1	2.2	1.8	2.2	2.2
19	13.4	12.2	11.0	14.8	7.5	5.3	3.0	2.2	1.8	2.2	2.2
20	13.3	11.8	10.8	14.4	7.4	5.3	3.0	2.0	1.8	2.2	2.2
21	13.0	11.5	10.6	14.1	7.2	5.1	2.9	2.3	1.8	2.2	2.1
22	12.8	11.25	10.3	14.1	7.1	5.0	2.9	2.0	1.8	2.2	2.1
23	12.5	11.0	10.2	14.0	6.9	4.8	2.9	2.0	1.8	2.2	2.0
24	12.3	10.8	10.2	13.8	6.7	4.8	2.8	2.0	1.8	2.3	2.0
25	12.5	10.6	11.2	13.6	6.4	4.6	2.7	2.0	1.8	2.3	1.9
26	12.6	10.5	12.0	13.4	6.2	4.5	2.7	2.0	2.1	2.3	1.9
27	12.9	10.3	12.7	13.1	6.1	4.9	2.6	2.0	2.2	2.2	1.9
28	13.0	10.1	13.0	13.0	6.0	5.0	2.6	2.0	2.2	2.2	1.9
29	13.25	10.0	13.1	13.0	5.9	4.8	2.6	2.0	2.2	2.2	1.9
30		10.0	13.1	13.0	5.8	4.5	2.6	2.0	2.2	2.2	2.0
31		10.3		13.0		4.4	2.8		2.2		2.0

SOUTH FORK OF SANGAMON RIVER NEAR TAYLORVILLE, ILL.

This station, which is located at the Wabash Railroad bridge, about 3½ miles southwest of Taylorville, Ill., was established February 11, 1908, to obtain data to be used in studying drainage, water supply, and flood control.

Bear Creek, a small tributary, enters the stream from the southwest, a few miles below the station. The drainage area above the section is about 412 square miles.

The datum of the gage has not been changed. The records are reliable and accurate.

The daily and monthly discharge has not been determined on account of insufficient data.

Discharge measurements of South Fork of Sangamon River near Taylorville, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 25	R. J. Taylor	122	484	4.55	159
June 9	do	85	345	3.3	88

Daily gage height, in feet, of South Fork of Sangamon River near Taylorville, Ill., for 1908.

[R. J. Hanon, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.0	6.9	7.0	4.8	.....	1.1	1.1	0.6	0.6	1.2
2	.....	7.6	6.7	6.3	4.7	.....	1.0	.9	.6	.6	1.2
3	.....	8.2	7.2	6.6	4.6	.....	.9	.7	.5	.6	1.2
4	.....	8.2	7.4	6.9	4.4	.....	.9	.7	.5	.6	1.3
5	.....	7.8	7.0	11.2	.....	.....	.8	.6	.5	.6	1.1
6	.....	7.9	6.7	12.8	.....	.....	.9	.7	.5	.6	1.1
7	.....	8.0	6.8	12.4	3.3	.....	.9	.6	.5	.6	1.0
8	.....	8.1	7.0	12.3	3.2	.....	.8	.6	.5	.6	1.0
9	.....	8.5	7.0	12.1	3.3	.....	.8	.6	.5	.7	1.0
10	.....	8.0	7.5	10.0	3.4	.....	.9	.6	.5	.7	1.0
11	7.0	7.8	7.4	9.0	3.4	.....	.9	.6	.4	.7	1.0
12	6.2	7.8	7.1	9.3	3.3	.....	.9	.5	.4	.7	1.0
13	5.8	7.4	6.6	9.1	3.2	.....	.9	.5	.4	.8	1.0
14	6.4	6.9	6.2	8.6	2.8	.....	.9	.5	.4	.8	.9
15	7.0	6.4	5.8	.....	3.3	.....	.9	.5	.4	.8	.9
16	9.3	6.0	5.5	.....	2.9	.....	.8	.5	.4	.8	.9
17	8.9	5.8	5.1	.....	2.7	.....	.8	.5	.4	.8	1.0
18	.....	5.4	4.9	.....	2.7	.....	.8	.5	.5	.8	1.0
19	8.2	5.0	4.8	.....	2.5	.....	.8	.5	.5	.8	1.0
20	7.7	5.3	4.8	.....	2.4	.....	.7	.4	.5	.8	1.0
21	7.3	5.1	4.6	.....	2.5	.....	.7	.4	.6	.8	.9
22	6.9	4.9	4.3	.....	2.3	.....	.6	.4	.6	.9	.9
23	6.7	4.7	4.1	.....	2.2	.....	.6	.5	.7	1.1	.9
24	6.7	4.6	6.9	8.9	2.0	.....	.6	.6	.7	1.2	.9
25	7.6	4.5	7.7	8.1	1.9	.....	.5	.6	.8	1.3	.9
26	9.9	4.5	8.0	7.7	1.8	.....	.5	.6	.9	1.1	.9
27	10.3	4.1	8.3	6.9	1.8	.....	.5	.7	.9	1.1	.8
28	9.5	4.2	8.2	6.8	1.6	.....	.4	.7	.8	.9	.8
29	8.6	4.6	8.0	6.7	1.9	1.4	2.4	.6	.7	.9	1.4
30	.....	4.6	7.6	.....	1.8	1.3	1.6	.6	.6	1.4	1.4
31	.....	4.5	.....	4.8	.....	1.1	1.3	.....	.6	.....	1.3

SALT CREEK NEAR KENNEY, ILL.

This station, which is located at the highway bridge a short distance below the Vandalia Railroad bridge, about 3 miles west of Kenney, Ill., was established February 14, 1908, to collect data for use in studies of drainage and flood-control problems. This stream is a tributary of Sangamon River.

No tributaries enter near the station. The drainage area above the section is about 398 square miles.

The datum of the gage has not been changed. The records are reliable and accurate.

The daily and monthly discharge has not yet been determined because of insufficient data.

Discharge measurements of Salt Creek near Kenney, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	R. J. Taylor	157	1,280	10.5	3,240
July 28	do	107	178	2.1	64

Daily gage height, in feet, of Salt Creek near Kenney, Ill., for 1908.

[Chris McDermott, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.9	3.4	5.6	4.6	2.8	1.9	1.6	1.5	1.9	1.9
2		6.6	3.6	5.2	4.2	2.8	1.8	1.6	1.5	1.9	1.8
3		7.0	3.3	4.8	4.0	2.6	1.8	1.6	1.5	1.8	1.8
4		7.0	3.2	8.0	4.0	2.4	1.9	1.6	1.6	1.8	1.8
5		7.1	3.4	9.0	3.8	2.3	1.9	1.6	1.6	1.8	1.8
6		7.7	3.3	10.7	3.9	2.4	1.9	1.6	1.6	1.8	1.8
7		7.8	3.7	10.1	3.7	2.4	1.9	1.6	1.5	1.8	1.8
8		7.1	4.2	10.7	3.6	2.3	1.8	1.6	1.6	1.8	1.8
9		6.6	4.6	11.6	3.3	2.2	1.8	1.6	1.5	1.7	1.8
10		6.0	4.8	10.5	3.2	2.1	1.9	1.5	1.5	1.8	1.8
11		5.0	4.7	9.8	3.2	2.1	1.9	1.6	1.5	1.9	1.7
12		5.2	4.4	13.0	3.0	2.1	1.9	1.6	1.5	1.7	1.7
13		4.9	4.0	15.0	2.9	2.0	2.0	1.7	1.5	1.9	1.7
14	8.0	4.7	3.9	12.0	2.9	2.0	2.0	1.6	1.5	1.7	1.7
15	9.1	4.6	4.9	12.7	3.0	2.1	1.9	1.5	1.5	1.7	1.7
16	10.1	4.0	5.2	10.0	2.9	3.2	1.8	1.4	1.6	1.8	1.7
17	9.1	3.9	4.9	8.7	2.8	2.6	1.9	1.4	1.7	1.8	1.7
18	6.1	3.8	4.9	8.0	2.8	2.5	1.8	1.3	1.5	1.7	1.8
19	4.2	4.2	4.6	8.6	2.9	2.2	1.8	1.4	1.8	1.8	1.7
20	3.6	4.6	4.2	8.9	2.9	2.1	1.9	1.4	1.9	1.9	1.7
21	4.0	4.4	4.0	8.0	2.8	2.1	1.8	1.4	1.9	1.8	1.7
22	4.6	4.0	3.7	8.1	2.8	2.0	1.7	1.4	1.9	1.8	1.7
23	4.8	4.0	3.2	7.0	2.8	3.4	1.7	1.4	1.8	1.8	1.7
24	5.4	3.9	5.8	6.6	2.7	2.2	1.7	1.4	1.9	1.8	1.6
25	7.4	3.8	7.0	5.9	2.6	2.0	1.6	1.4	1.8	1.8	1.7
26	8.0	3.8	7.6	5.9	2.5	2.0	1.6	1.5	1.8	1.8	1.7
27	8.3	3.4	7.6	5.6	2.4	3.8	1.6	1.7	1.8	1.8	1.8
28	7.7	3.6	7.5	5.1	2.3	3.0	1.6	1.6	1.8	1.8	1.7
29	6.8	3.5	6.8	5.5	2.7	2.2	1.7	1.5	1.8	1.8	1.9
30		3.3	6.0	5.3	2.8	2.0	1.6	1.5	1.8	1.8	2.3
31		3.3		4.9		1.9	1.6		1.9		2.1

KASKASKIA RIVER DRAINAGE BASIN.

DESCRIPTION.

Kaskaskia River, also called the Okaw, lies wholly in the State of Illinois. The river rises in the center of Champaign County, flows southwestward, and empties into the Mississippi River in Randolph County near the city of Chester, Ill. It is about 190 miles in length, not following the bends, but as it is very crooked, its length by course is not far from 400 miles. The total drainage area is about 5,710 square miles. It has few tributaries worthy of mention, the most important being Shoal and Silver Creeks, which enter from the north at the lower part of the river.

The drainage basin is long and comparatively narrow, the average width being about 30 miles, the maximum width about 60 miles. The ground is low, level, or undulating, and in consequence the slope of the river is small. The sources of the river are about 740 feet and its mouth about 350 feet above sea level. The soil is mostly black loam. In the lower portion of the drainage area the soil gradually changes to a yellowish brown clay. The only rock exposure of any extent along this stream is found about 20 miles above Shelbyville. In this 15 or 20 mile section the banks and bed are largely of limestone or sandstone; elsewhere they are mostly soft soil with some gravel.

The basin contains no forested areas. The annual rainfall is about 40 inches. As a rule the winters are mild.

Possibilities for storage have not been investigated to any extent. Opportunities for important water-power development are entirely lacking.

Because of the lowness of its drainage area, the basin affords little ground storage. During wet weather the ground-water plane rises to the surface, and the rains run off into the streams very quickly, producing very sudden rises and floods; in dry weather, as there is little or no ground water stored, the flow of the stream becomes very small and in some places dries up entirely. The banks of the river are low, and in times of floods large areas are covered with water, delaying the planting of crops and at times destroying growing crops. Storage possibilities, land drainage, and flood control are subjects of considerable importance in this basin.

The following gaging stations have been established and maintained in this drainage basin:

Kaskaskia River near Arcola, Ill., 1908.
Kaskaskia River at Shelbyville, Ill., 1908.
Kaskaskia River at Vandalia, Ill., 1908.
Kaskaskia River at Carlyle, Ill., 1908.
Silver Creek near Lebanon, Ill., 1908.

KASKASKIA RIVER NEAR ARCOLA, ILL.

This station, which is located at the highway bridge, known as Bagdad Bridge, about 4 miles west of the town of Arcola, Ill., was established April 11, 1908, to obtain data for use in studies of drainage, flood protection, and storage problems.

Lake Fork enters from the west 3 or 4 miles above the gaging station. The drainage area above the station is about 356 square miles.

The datum of the gage has remained unchanged. The records are reliable and accurate. Sufficient data have not yet been obtained to determine the daily and monthly discharge.

Discharge measurements of Kaskaskia River near Arcola, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 29	R. J. Taylor	226	1,180	10.0	1,250
July 24	do	68.5	75	2.75	44

Daily gage height, in feet, of Kaskaskia River near Arcola, Ill., for 1908.

[Lawrence L. Pfeifer, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	8.7	5.8	3.1	2.6	0.9	16	6.7	11.4	4.7	3.6	.....	.....
2	.....	8.2	5.7	3.0	.....	.8	17	6.3	.....	4.6	3.4	1.6	.....
3	.....	.....	5.5	3.0	2.4	.8	18	6.1	9.7	4.4	3.4	1.6	.....
4	.....	8.0	5.7	3.4	2.2	.8	19	.....	9.6	4.3	.....	1.6	.....
5	.....	12.0	5.6	.....	2.1	.7	20	5.9	9.8	4.3	3.5	1.5	.....
6	.....	13.2	5.4	3.2	2.1	.....	21	5.6	10.0	.....	3.5	1.5	.....
7	.....	16.2	.....	3.6	2.0	.6	22	5.4	9.7	4.1	3.4	1.5	.....
8	.....	17.3	5.2	3.4	2.0	.6	23	5.3	9.3	4.0	3.3	.....	.....
9	.....	16.7	5.4	3.2	.....	.6	24	6.4	.....	3.9	3.0	1.3	.....
10	.....	.....	5.5	3.0	1.9	.5	25	8.2	8.6	3.8	2.9	1.3	.....
11	8.5	14.7	5.4	2.9	1.9	.5	26	.....	8.1	3.7	.....	1.2	.....
12	.....	13.5	5.3	.....	1.9	.5	27	9.8	7.7	3.5	2.8	1.2	.....
13	7.7	12.9	5.2	2.7	1.8	.....	28	9.9	7.3	.....	2.8	1.1	.....
14	7.3	11.9	.....	2.7	1.8	.....	29	10.0	7.0	3.3	2.7	1.0	.....
15	7.0	11.6	4.8	2.6	1.8	.....	30	9.4	6.9	3.3	2.7	.....	.....
							31	.....	6.8	.....	2.7	.9	.....

NOTE.—No flow from August 31 to December 31.

KASKASKIA RIVER AT SHELBYVILLE, ILL.

This station is located at the highway bridge over Kaskaskia River, a short distance above the Chicago and Eastern Illinois Railroad bridge at Shelbyville, Ill. It was established February 28, 1908, to obtain data for use in studying drainage and flood-control problems.

No important tributaries enter the stream near Shelbyville. The drainage area above this point is about 983 square miles.

The station has not been maintained long enough to know definitely about ice conditions. The gage heights may be affected during high stages by backwater caused by lodging of drift at the two railroad bridges below the station.

The datum of the gage has remained unchanged. The records are reliable and accurate. Sufficient data are not yet available for the determination of daily and monthly discharge.

Discharge measurements of Kaskaskia River at Shelbyville, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 24	R. J. Taylor	147	975	11.53	2,350
April 29	do	149	1,020	12.2	2,720
June 10	do	113	1,010	8.7	1,080
July 21	do	103	713	6.3	218

Daily gage height, in feet, of Kaskaskia River at Shelbyville, Ill., for 1908.

[Homer Pounds, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		15.1	11.6	11.8	8.6	6.4	5.8	5.4	5.3	4.9	5.4
2		15.5	12.8	11.4	8.4	6.3	5.7	5.3	5.2	5.0	5.4
3		16.4	11.8	10.4	8.3	6.4	5.7	5.3	5.2	5.0	5.4
4		16.0	11.4	21.2	8.8	6.3	5.6	5.2	5.2	5.1	5.3
5		15.6	9.9	22.8	8.4	6.3	5.6	5.2	5.1	5.1	5.3
6		15.4	9.6	22.3	8.1	6.4	5.5	5.2	5.1	5.2	5.3
7		15.8	9.5	22.7	7.8	6.7	5.5	5.2	5.1	5.2	5.3
8		16.2	11.5	25.8	7.6	6.8	5.5	5.2	5.1	5.2	5.3
9		16.6	11.7	23.6	8.0	6.9	5.6	5.1	5.1	5.2	5.3
10		17.0	11.8	21.2	8.4	6.6	5.7	5.1	5.1	5.2	5.4
11		16.8	11.5	20.2	8.3	6.5	5.7	5.0	5.1	5.2	5.4
12		15.8	11.3	19.5	7.9	6.5	5.6	5.0	5.1	5.2	5.4
13		14.8	11.1	18.8	7.6	6.3	5.7	5.0	5.1	5.2	5.4
14		14.2	11.0	17.9	7.5	6.2	5.6	5.0	5.1	5.2	5.4
15		13.6	10.1	17.0	7.3	6.0	5.6	5.0	5.0	5.2	5.4
16		13.1	9.6	16.4	7.0	6.0	5.5	5.0	5.0	5.3	5.4
17		11.9	8.9	15.9	6.9	5.9	5.5	5.1	5.0	5.3	5.3
18		10.9	8.8	15.0	6.7	5.8	5.5	5.1	5.0	5.3	5.3
19		10.0	8.7	14.9	6.6	6.1	5.4	5.1	5.0	5.3	5.3
20		10.1	8.6	13.7	6.8	6.1	5.4	5.1	5.0	5.3	5.3
21		9.7	8.5	12.8	6.7	6.1	5.4	5.1	5.0	5.3	5.3
22		9.6	8.4	13.7	6.7	6.0	5.3	5.0	5.0	5.4	5.3
23		9.5	8.3	13.1	6.6	6.0	5.3	5.0	4.9	5.4	5.3
24		9.4	10.1	12.6	6.5	5.9	5.3	5.0	4.9	5.5	5.3
25	14.2	9.3	10.6	12.0	6.5	5.8	5.3	5.0	4.9	5.5	5.2
26	16.4	9.0	11.2	11.5	6.4	5.8	5.3	5.0	5.0	5.6	5.2
27	17.0	8.7	11.8	11.3	6.3	5.7	5.3	5.0	5.0	5.6	5.2
28	16.6	8.5	12.2	10.0	6.1	5.7	5.2	5.1	5.0	5.5	5.3
29	15.3	8.9	12.4	9.8	6.2	5.6	5.2	5.2	4.9	5.5	5.3
30		8.9	11.9	9.4	6.3	5.7	5.3	5.3	4.9	5.5	5.4
31		8.7		9.0		5.8	5.3		4.9		5.4

KASKASKIA RIVER AT VANDALIA, ILL.

This station, which is located at the highway bridge at the east end of Main street, Vandalia, Ill., was established February 26, 1908, to obtain data for use in studying drainage questions, flood protection, and levee construction. No important tributaries enter the

river near Vandalia. The drainage area above this point is about 1,880 square miles.

Records have not been kept long enough to know much about ice conditions. The river for some miles above and below Vandalia is leveed. During extreme floods these levees sometimes give way, thus reducing the flood flow; all the water, however, eventually passes the gaging section.

The datum of the gage has remained unchanged. The records are reliable and accurate.

Insufficient data have been collected at this station to allow of the determination of daily and monthly discharge.

Discharge measurements of Kaskaskia River at Vandalia, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 26	R. J. Taylor	155	2,350	18.53	6,870
March 19	do	128	1,510	10.1	2,400
March 20	do	128	1,430	9.6	2,130
April 30	do	151	1,890	12.9	3,600
July 6	do	112	713	3.6	287
August 6	do	106	563	2.3	84

Daily gage height, in feet, of Kaskaskia River at Vandalia, Ill., for 1908.

[W. F. Radcliff, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		18.2	8.2	11.7	7.4	4.0	2.4	2.0	1.5	1.3	1.8
2		18.0	12.0	11.0	7.5	3.8	2.3	1.9	1.5	1.3	1.7
3		17.8	13.2	10.6	7.0	3.9	2.2	1.7	1.6	1.3	1.7
4		17.6	12.2	13.9	6.6	3.8	2.0	1.6	1.6	1.3	1.6
5		17.2	10.5	17.1	6.6	3.6	1.9	1.5	1.6	1.3	1.6
6		17.4	10.4	21.2	6.8	3.6	2.0	1.5	1.5	1.3	1.6
7		17.8	10.3	20.5	6.6	3.5	2.1	1.5	1.5	1.3	1.6
8		17.4	12.4	20.8	6.4	3.6	2.2	1.4	1.4	1.2	1.7
9		18.0	15.0	19.9	5.6	4.4	1.8	1.4	.....	1.2	1.8
10		18.8	15.6	19.2	5.8	4.3	1.8	1.5	.....	1.2	1.8
11		18.9	14.2	18.5	6.3	4.0	1.7	1.5	.....	1.3	1.8
12		18.4	12.2	18.1	6.0	3.7	1.6	1.4	1.3	1.3	1.8
13		17.7	10.6	18.1	6.1	3.5	1.8	1.4	1.3	1.3	1.8
14		17.0	9.8	17.7	5.8	3.3	2.0	1.5	1.3	1.3	1.7
15		16.3	9.4	17.3	5.2	3.2	2.0	1.5	1.3	1.3	1.7
16		14.6	9.0	17.1	5.2	3.2	2.2	1.5	1.3	1.3	1.7
17		12.7	8.2	17.0	4.8	3.4	2.4	1.5	1.3	1.4	1.7
18		11.3	8.0	16.8	4.6	3.8	2.6	1.4	1.3	1.5	1.7
19		10.0	8.2	16.5	4.5	3.6	2.3	1.4	1.3	1.5	1.7
20		9.6	8.3	16.0	4.8	3.6	2.2	1.5	1.3	1.6	1.7
21		9.2	7.7	15.0	6.6	3.6	2.0	1.2	1.3	1.6	1.7
22		8.8	6.9	14.9	5.6	3.8	1.9	1.2	1.3	1.6	1.6
23		8.7	6.5	16.6	5.0	3.2	1.8	1.4	1.3	1.6	1.6
24		8.7	9.9	16.8	4.6	3.0	1.7	1.4	1.3	1.6	1.6
25		8.6	15.1	15.9	4.2	2.9	1.6	1.3	1.3	1.6	1.6
26	18.4	8.2	16.2	14.4	4.1	2.8	1.6	1.3	1.3	1.7	1.6
27	19.5	7.8	16.3	12.1	4.0	2.7	1.5	1.4	1.3	1.7	1.6
28	19.8	7.6	16.2	10.6	3.7	2.7	1.5	1.4	1.3	1.8	1.5
29	19.0	7.4	15.4	9.6	3.5	2.6	1.5	1.5	1.3	1.8	1.5
30		7.2	13.0	9.0	4.4	2.6	1.6	1.5	1.3	1.8	1.5
31		7.1	.....	8.4	.....	2.4	1.7	.....	1.3	.....	1.5

KASKASKIA RIVER AT CARLYLE, ILL.

This station, which is located at the Baltimore and Ohio Southwestern Railroad bridge, about one-fourth mile east of the railroad station at Carlyle, Ill., was established March 2, 1908, to obtain data for use in studying problems of drainage and flood control along this section of the river.

No important tributaries enter within 10 miles above or below the station. The drainage area above the gaging station is about 2,630 square miles.

The station has not been maintained long enough to determine the ice conditions. The river is subject to high floods and extreme low water. The datum of the gage has remained unchanged. The records of the gage heights are reliable and accurate. Low-water discharge figures should be used with caution, as another year's records are needed to verify the measurements made this year. Insufficient data are available for the determination of the daily and monthly discharge.

Discharge measurements of Kaskaskia River at Carlyle, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 23	R. J. Taylor	196	1,770	16.7	2,830
May 4	do	512	3,770	21.35	5,360
July 8	do	131	335	8.1	426
August 7	do	124	239	7.1	289
September 24	do			5.6	[a] 62
October 22	do			5.6	[a] 32

[a] Discharge partly estimated.

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill., for 1908.

[Mike Schilling, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	13.9	22.2	19.1	8.0	7.5	6.1	5.6	5.6	5.6
2	23.7	16.1	22.1	15.6	8.2	7.3	6.0	5.6	5.6	5.6
3	23.6	17.6	21.8	13.3	8.2	7.0	6.0	5.6	5.6	5.9
4	23.3	18.2	21.3	12.5	8.1	6.8	5.9	5.6	5.6	5.9
5	23.1	18.5	21.8	11.9	8.0	6.7	5.8	5.6	5.6	5.9
6	22.9	18.4	23.1	11.6	8.1	7.1	5.8	5.6	5.6	5.9
7	22.8	18.0	24.9	11.7	8.1	7.1	5.9	5.6	5.6	5.9
8	22.8	18.0	29.1	11.2	8.0	7.2	5.9	5.6	5.6	5.9
9	22.8	19.0	30.8	11.1	8.0	6.9	5.8	5.6	5.6	5.7
10	23.1	19.9	30.0	11.9	7.7	6.7	5.9	5.6	5.6	5.7
11	23.6	20.7	28.8	11.0	8.5	6.7	5.7	5.6	5.6	5.7
12	23.7	21.2	27.3	10.6	8.2	6.5	5.7	5.6	5.6	5.7
13	23.4	21.5	26.3	10.6	8.0	6.6	5.7	5.6	5.6	5.7
14	23.3	21.5	25.5	10.5	8.0	6.6	5.7	5.6	5.6	5.7
15	23.0	21.3	24.9	10.4	7.8	6.5	5.7	5.6	5.6	5.7
16	22.7	20.5	24.4	9.8	7.6	6.5	5.6	5.6	5.6	5.7
17	22.4	19.1	24.0	9.7	7.7	6.5	5.7	5.6	5.6	5.7
18	22.2	17.1	23.6	9.4	7.9	6.4	5.7	5.6	5.6	5.7
19	21.9	15.9	23.3	9.1	7.8	6.4	5.6	5.6	5.6	5.7
20	21.6	14.8	23.0	8.9	8.2	6.4	5.7	5.6	5.6	5.7

Daily gage hight, in feet, of Kaskaskia River at Carlyle, Ill., for 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	20.8	14.0	22.7	9.3	8.1	6.3	5.7	5.6	5.6	5.7
22	18.3	12.8	23.1	10.3	8.6	6.1	5.6	5.6	5.6	5.6
23	16.6	12.3	22.9	10.3	9.3	6.0	5.7	5.6	5.6	5.6
24	14.9	15.4	22.7	9.3	9.2	6.0	5.7	5.6	5.6	5.6
25	13.6	18.1	22.5	9.0	8.3	5.9	5.6	5.6	5.6	5.6
26	13.1	19.9	22.2	8.6	8.5	5.9	5.6	5.6	5.6	5.6
27	12.6	21.2	22.0	8.5	9.4	5.9	5.6	5.6	5.6	5.6
28	12.3	21.7	21.9	8.4	9.3	5.9	5.6	5.6	5.6	5.6
29	12.7	22.0	21.8	8.5	8.2	6.1	5.6	5.6	5.6	5.6
30	12.8	22.2	21.8	8.3	8.0	6.5	5.6	5.6	5.6	5.6
31	12.9	.....	20.6	.....	7.6	6.5	.....	5.6	.....	5.6

SILVER CREEK NEAR LEBANON, ILL.

Silver Creek is a tributary of Kaskaskia River, emptying into it just above New Athens. The gaging station, which is located at the highway bridge about 2 miles west of the town of Lebanon, Ill., was established March 3, 1908, to obtain data for use in studying drainage and flood-control problems.

No tributaries enter near the gaging station. The drainage area above the station is about 328 square miles.

The datum of the gage has not been changed. The records are reliable and accurate.

Sufficient data have not yet been collected to determine the daily and monthly discharge.

Discharge measurements of Silver Creek near Lebanon, Ill., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 21	R. J. Taylor	38	111	3.5	71
May 2	do	41	130	4.25	107
July 9	do	35	107	3.5	58

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1908.

[F. P. Myers, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.5	5.1	3.7	2.5	2.0	.....	.....	.....	3.2
2	.....	4.4	4.4	3.4	2.0	.....	.....	.....	.....	2.7
3	.....	4.3	.....	3.2	2.3	2.0	.....	.....	.....	.....
4	.....	4.0	4.2	5.4	2.5	.....	.....	.....	.....	.....
5	.....	.....	13.9	6.2	.....	.....	.....	.....	.....	.....
6	.....	4.0	15.5	6.0	2.5	3.9	.....	.....	.....	.....
7	.....	4.3	15.9	.....	4.0	6.5	.....	.....	.....	.....
8	.....	5.0	15.5	5.2	5.4	5.8	.....	.....	.....	.....
9	.....	10.4	14.1	6.0	3.5	.....	.....	.....	.....	.....
10	.....	11.0	.....	7.8	2.7	5.0	.....	.....	.....	.....
11	.....	11.0	11.9	5.0	2.3	4.7	.....	.....	.....	.....
12	.....	.....	9.8	3.6	.....	4.2	.....	.....	.....	.....
13	.....	5.3	5.8	4.2	2.0	3.0	.....	.....	.....	.....
14	.....	4.2	7.2	.....	2.0	2.0	.....	.....	.....	.....
15	.....	4.2	6.2	10.8	2.3	2.0	.....	.....	.....	.....

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1908 Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16		4.8	4.9	7.5	3.0					
17		4.8		5.0	4.0					
18		4.8	6.6	3.2	5.2					
19			6.0	2.8						
20		4.5	5.3	2.6	2.7					
21	3.5	3.9	4.1		4.2					
22		3.5	11.0	3.5	5.1					
23	3.4	5.2	12.2	2.7	3.6					
24	3.3	11.1		4.5	3.6					
25	3.3	11.3	12.4	3.2	3.6					
26	3.2		11.8	2.5						
27	3.1	12.5	8.6	2.0	3.8					
28	3.5	12.1	11.0		7.5					
29		11.7	7.8	8.9	6.5					
30	3.7	8.8	7.0	2.8	3.5				3.4	
31	4.3				2.5					

NOTE.—The gage at this station was not set over the main channel, hence for stages below 2.0 feet, which occurred August 4 and 5, August 16 to November 29, and December 3–31, 1908, the stream was dry immediately under the gage. There was water flowing in the main channel for all but about one week during these periods.

BIG MUDDY RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Big Muddy River lies in southern Illinois. The river rises in the northwestern part of Jefferson County, flows southward to the town of Zeigler, in Franklin County, thence westward to Murphysboro, in Jackson County, and then southward to its junction with the Mississippi about 40 miles above Cairo, Ill. Below Zeigler the river is extremely crooked. The total drainage area is about 2,230 square miles. The principal tributaries are Beaucoup Creek, Little Muddy River, Caseys Creek, and Middle Fork Creek—all small streams of little importance.

The drainage basin is elliptical in shape, with a major axis about 70 miles long and a minor axis about 50 miles long. The country is level or undulating. The soil is known as "mulatto soil"—a yellowish-brown clay. Winter wheat is the staple crop. The southeastern part is underlain with valuable coal veins and coal mining is carried on quite extensively.

The slope of the river is small. Its sources are about 710 feet, and its mouth is about 310 feet, above sea level. The banks and bed of the stream are soft and insecure.

The area is timberless except for occasional groves and the growth along the banks of the streams.

The mean annual rainfall is about 42 inches. The winters are mild. Ice does not form very thick, and, as a rule, the snowfall is light and does not last long.

Storage possibilities have not been investigated, but owing to the growing demand for water in this section they should receive careful attention.

The basin offers no opportunities for power development. Like the other rivers in central and southern Illinois, this stream is subject to high floods and very low water. In some localities the high water overflows the land on each bank for 2 or 3 miles; some sections resemble a lake during floods. Backwater from the Mississippi frequently extends to Murphysboro, said to be 60 miles distant following the river, and floods reach the height of 30 feet above low water. It is possible that a canal will be constructed from the Mississippi to the coal fields that lie along the Big Muddy. It is thought that only one lock would be necessary. Canal construction would probably be very simple, as the country is low and the material excavated very soft.

The following gaging stations are being maintained in this drainage basin:

Big Muddy River near Cambon, Ill., 1908.
Beaucoup Creek near Pinckneyville, Ill., 1908.

BIG MUDDY RIVER NEAR CAMBON, ILL.

This station, which is located at the Chicago, Burlington and Quincy Railroad bridge about 1 mile north of Cambon railroad station near Plumfield, Ill., was established June 16, 1908, to obtain data for use in studying problems of drainage, flood control, and navigation.

The Middle Fork of the Big Muddy enters above the station. The drainage area above the section is about 788 square miles.

The datum of the gage has not been changed. The records are reliable and accurate. The daily and monthly discharge has not been determined because of insufficient data.

The following discharge measurement was made:

June 15, 1908: Width, 41.5 feet; area, 53 square feet; gage height, 2.7 feet; discharge, 19 second-feet.

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for 1908.

[W. O. Bourland, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.6	3.8	1.5	1.3	1.1	1.5
2		1.6	3.0	1.5	1.3	1.1	1.5
3		1.6	2.7	1.5	1.3	1.1	1.5
4		1.6	2.4	1.5	1.2	1.1	1.5
5		1.6	2.2	1.5	1.3	1.1	1.5
6		1.6	2.5	1.5	1.3	1.1	1.5
7		1.6	3.5	1.5	1.3	1.1	1.5
8		1.6	3.2	1.5	1.3	1.1	1.5
9		1.6	3.0	1.5	1.3	1.1	1.5
10		1.6	3.8	1.5	1.3	1.3	1.5
11		1.6	3.5	1.5	1.3	1.3	1.5
12		1.6	3.5	1.4	1.3	1.3	1.5
13		1.6	2.7	1.4	1.3	1.3	1.5
14		1.6	2.5	1.4	1.3	1.3	1.5
15		1.6	2.3	1.4	1.3	1.3	1.5

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for 1908—Continued.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2.5	1.6	2.1	1.4	1.3	1.3	1.5
17	2.3	1.6	1.9	1.4	1.3	1.3	1.5
18	2.2	1.6	1.9	1.4	1.3	1.3	1.5
19	2.1	1.6	1.8	1.4	1.3	1.3	1.5
20	2.0	1.6	1.8	1.4	1.2	1.3	1.5
21	2.0	1.6	1.7	1.4	1.2	1.3	1.5
22	1.9	1.6	1.7	1.4	1.2	1.3	1.5
23	1.9	4.1	1.6	1.4	1.2	1.3	1.5
24	1.8	2.8	1.6	1.4	1.2	1.5	1.5
25	1.8	2.1	1.6	1.4	1.2	1.5	1.5
26	1.7	1.9	1.6	1.4	1.2	1.5	1.5
27	1.7	1.8	1.6	1.4	1.2	1.5	1.5
28	1.6	1.7	1.6	1.4	1.1	1.5	1.5
29	1.6	1.6	1.5	1.4	1.1	1.5	1.5
30	1.6	4.7	1.5	1.4	1.1	1.5	1.5
31	.....	4.9	1.5	.....	1.1	.....	1.5

BEAUCOUP CREEK NEAR PINCKNEYVILLE, ILL.

This station, which is located at the Illinois Central Railroad bridge, 1½ miles east of Pinckneyville, Ill., was established June 17, 1908, to collect data for use in studying drainage and flood-control problems.

The drainage area above the station is about 206 square miles.

Gage heights were observed whenever the gage reader happened to be in the vicinity of the gage. Except in a few cases, however, fairly accurate results will be obtained if the missing gage heights will be interpolated.

The following discharge measurement was made:

June 17, 1908: Width, 53 feet; area, 48 square feet; gage height, 2.3 feet; discharge 12 second-feet.

Daily gage height, in feet, of Beaucoup Creek near Pinckneyville, Ill., for 1908.

[R. C. Huggins, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	.....	.....	.....	.....	2.0
2	.....	.....	.....	1.6	.....	.....	.....
3	.....	2.3	1.9	.....	1.2	.....	.....
4	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	1.6	.....	1.0	1.9
6	.....	.....	2.9	.....	.....	.....	.....
7	.....	.....	6.0	.....	.....	.....	.....
8	.....	2.2	.....	1.6	.....	.....	.....
9	.....	.....	.....	.....	.....	.....	1.8
10	.....	.....	.....	.....	1.2	.....	.....
11	.....	2.0	2.3	.....	.....	1.0	.....
12	.....	.....	.....	.....	.....	.....	1.8
13	.....	.....	.....	1.6	.....	.....	.....
14	.....	1.9	.....	.....	.....	.....	.....
15	.....	.....	2.0	.....	.....	.....	.....
16	.....	.....	.....	.....	.....	.....	1.7
17	2.3	.....	.....	.....	1.0	.....	.....
18	.....	1.8	1.8	.....	.....	.....	.....
19	2.0	.....	.....	1.5	.....	.....	1.7
20	2.0	.....	.....	.....	.....	.....	.....

Daily gage height, in feet, of Beaucoup Creek, near Pinckneyville, Ill., for 1908—Con.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21		1.8			1.0	1.0	1.7
22			1.4	1.3			
23							
24	1.8						
25	1.8	2.9	1.7				
26							1.6
27		3.5		1.2		1.0	
28					1.0		
29	1.8	2.8	1.7				1.6
30							
31							1.6

MISCELLANEOUS MEASUREMENTS IN HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGES.

MISCELLANEOUS MEASUREMENTS IN ST. MARY RIVER DRAINAGE BASIN.

Date.	Stream.	Locality.	Gage height.[a]	Discharge.
1907.			*Feet.*	*Sec.-ft.*
May 14	Kennedy Creek	Near Babb, Mont	6.26	240
June 6	do	do	6.95	979
July 2	do	do	7.10	919
August 8	do	do	6.25	152
September 7	do	do	6.11	87
1908.				
July 28	St. Mary Canal	Kimball, Alberta		323

[a] United States Geological Survey gage used, 1903–1906.

MISCELLANEOUS MEASUREMENTS IN RED RIVER DRAINAGE BASIN.

Date.	Stream.	Locality.	Gage height.	Discharge.
1908.			*Feet.*	*Sec.-ft.*
August 29	Goose River	Hillsboro, N. Dak		4.0
January 20	Red Lake River	East Grand Forks, Minn	6.74	449
April 13	do	do	30.95	8,980

MISCELLANEOUS MEASUREMENT IN WISCONSIN RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurement was made in the Wisconsin River drainage basin March 3, 1908:

Wisconsin River at Kilbourn, Wis.: Gage height, 1.50 feet; discharge, 3,090 second feet; average thickness of ice, 1.1 feet.

SUMMARY OF MEAN DISCHARGE PER SQUARE MILE.

The following summary of discharge per square mile is given to allow ready comparison of relative rates of run-off from different areas in the upper Mississippi and Hudson Bay drainages.

It shows in a general way the seasonal distribution of run-off, and the effect of snow, ground, surface, and artificial storage. The most important fact worth noting is the almost entire lack of uniformity or agreement between any two stations, which indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible.

Summary of discharge in second-feet per square mile in upper Mississippi River and Hudson Bay basins for 1907 and 1908.

Gaging station.	Drainage area.	1907.												1908.											
		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	Sq. miles.																									
St. Mary River near Babb, Mont	177	0.45	0.62	0.45	1.32	5.71	13.4	11.81	5.05	3.94	1.94	0.77	0.42	3.82	0.11	0.28	0.96	2.68	7.34	19.2	7.80	3.13	1.70	1.49	1.29	0.48	3.87
St. Mary River near Cardston, Alberta	452	.33	.44	.33	1.08	4.27	9.42	6.90	2.94	2.68	1.25	.54	.35	2.54	.11	.22	.50	1.87	5.51								
Swiftcurrent Creek near Babb, Mont	101	.50	.64	.50	1.69	7.06	15.0	9.03	3.83	3.83	1.55	.60	.41	3.72	.15	.25	.50	3.30	8.13	19.2	5.42	1.69	1.17	2.06	.91	.18	3.58
Ottertail River near Fergus Falls, Minn	1,310				.50	.54	.53	.43	.27	.23	.26	.26	.23		.20	.18	.15	.24	.32	.62	.52	.35	.28	.23	.20	.17	.29
Red River at Fargo, N. Dak	6,020				.48	.23	.36	.17	.09	.07	.08	.07	.05		.05	.04	.08	.18	.12	.29	.20	.12	.08	.07	.06	.05	.11
Red River at Grand Forks, N. Dak	25,000	.06	.04	.12	.59	.18	.24	.13	.08	.08	.08	.06	.05	.14	.04	.03	.08	.39	.23	.29	.13	.08	.07	.06	.05	.03	.12
Sheyenne River at Haggart, N. Dak	5,400				.11	.08	.05																				
Red Lake River at Crookston, Minn	5,520	.12	.08	.23	.79	.38	.40	.22	.16	.18	.19	.12	.11	.25	.08	.09	.11	.84	.68	.55	.24	.22	.21	.16	.14	.08	.28
Pembina River at Neche, N. Dak	2,940					.54	.17	.05	.01	.01	.02	.01	.01		.00	.00	.00	.13	.16	.08	.03	.02	.02				
Mouse River at Minot, N. Dak	8,400				.02	.18	.10	.06	.01	.00	.00	.00	.00		.00	.00	.00	.04	.02	.03	.02	.01	.01	.00	.00	.00	.01
Chippewa River near Eau Claire, Wis	6,740				2.24	1.85	1.08	.80	.49	1.32	.72	.54	.26		.31	.33	.48	1.91	2.43	1.65	.75	.48	.32	.26	.34	.25	.79
Black River at Neillsville, Wis	675				1.90	1.05	.27	.72	.14	.70	.15	.12						3.41	2.90	2.09	1.25	.08	.06	.17	.27		
Wisconsin River at Merrill, Wis	2,630	.81	.81	1.02	2.43	2.62	1.03	1.02	.52	1.41	.76	.52	.46	1.12	.57	.63	.65	2.52	2.23	1.60	1.15	.52	.40	.61	.51	.57	1.00
Wapsipinicon River at Stone City, Iowa[a]	1,310				.58	.30	.75	1.31	.90	.68	.58	.29						.52	1.08	1.24	1.32	.38	.22	.22	.21		
Cedar River at Cedar Rapids, Iowa	6,320	.86	.97	.96	.52	.28	.89	1.48	.96	.51	.43	.26	.24	.70	.18	.62	.85	.39	.95	1.32	.94	.30	.17	.17	.18	.17	.52

[a] Run-off per square mile for Wapsipinicon River at Stone City, Iowa, only roughly approximate; the values given in this table will be revised in a later report. See description, p. 103.

NOTE.—Values of run-off per square mile for Pembina and Mouse rivers, which appear in the above table as 0.00 second-foot, are less than 0.005 second-foot. See monthly discharge tables, pp. 60 and 64, for true values.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 246

SURFACE WATER SUPPLY OF THE UNITED STATES

1907–8

PART VI. MISSOURI RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

ROBERT FOLLANSBEE AND J. E. STEWART

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SURFACE WATER SUPPLY OF THE MISSOURI RIVER BASIN, 1907–8.

By Robert Follansbee and J. E. Stewart.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete, nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible, because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country.

These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would

add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel, that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually, and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface-water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
III	243	Ohio River basin.	VIII	248	Western Gulf of Mexico.
IV	244	St. Lawrence River basin.	IX	249	Colorado River basin.
V	245	Upper Mississippi River and Hudson Bay basins.	X	250	Great Basin.
			XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive, and dates also are inclusive, so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	do	1903.
W. S. 124 to 135	do	1904.
W. S. 165 to 178	do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907–8.
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65, 75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65, 75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65, 75	83	98	127	168	204	242
St. Lawrence River	36	49	65, 75	(82), 83	97	129	170	206	244
Hudson Bay	.....	.....	66, 75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48, (49)	65, 75	83	98	128	169	205	243
Upper Mississippi River	36	49	65, 75	83	98, (99)	128, (130)	171	207	245
Missouri River	(36), 37	49, (50)	66, 75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66, 75	(83), 84	(98), 99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66, 75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37), 38	50	66, 75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66, 95	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100	134	177	213	251
North Pacific coast	38	51	66, 75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Number of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.

1 horsepower equals 1 second-foot falling 8.80 feet.

1¼ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 13, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which

accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others, depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200[a]) and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The edition of the latter water-supply paper is nearly exhausted. It can, however, be consulted at most of the larger libraries of the country or can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

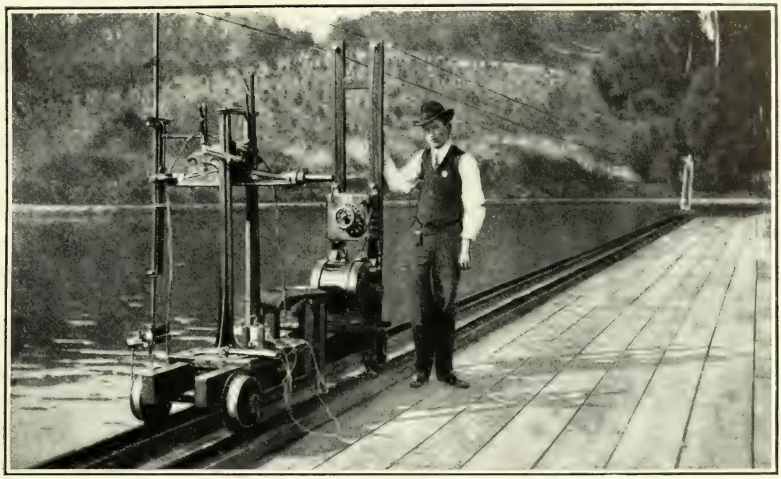
Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semipermanent or shifting sections with smooth, uniform current. So far as possible, stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth at the time of measurement.

The measuring points divide the total cross section into elementary strips, at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0.8 depth method.

strip. The sum of the discharges of the elementary strips is the total discharge of the stream. (For a discussion of methods of computing the discharge of a stream, see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method, with its various modifications of surface, subsurface, and tube or rod floats, is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolution of the wheel, is determined for each meter by drawing it through still water for a given distance

at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

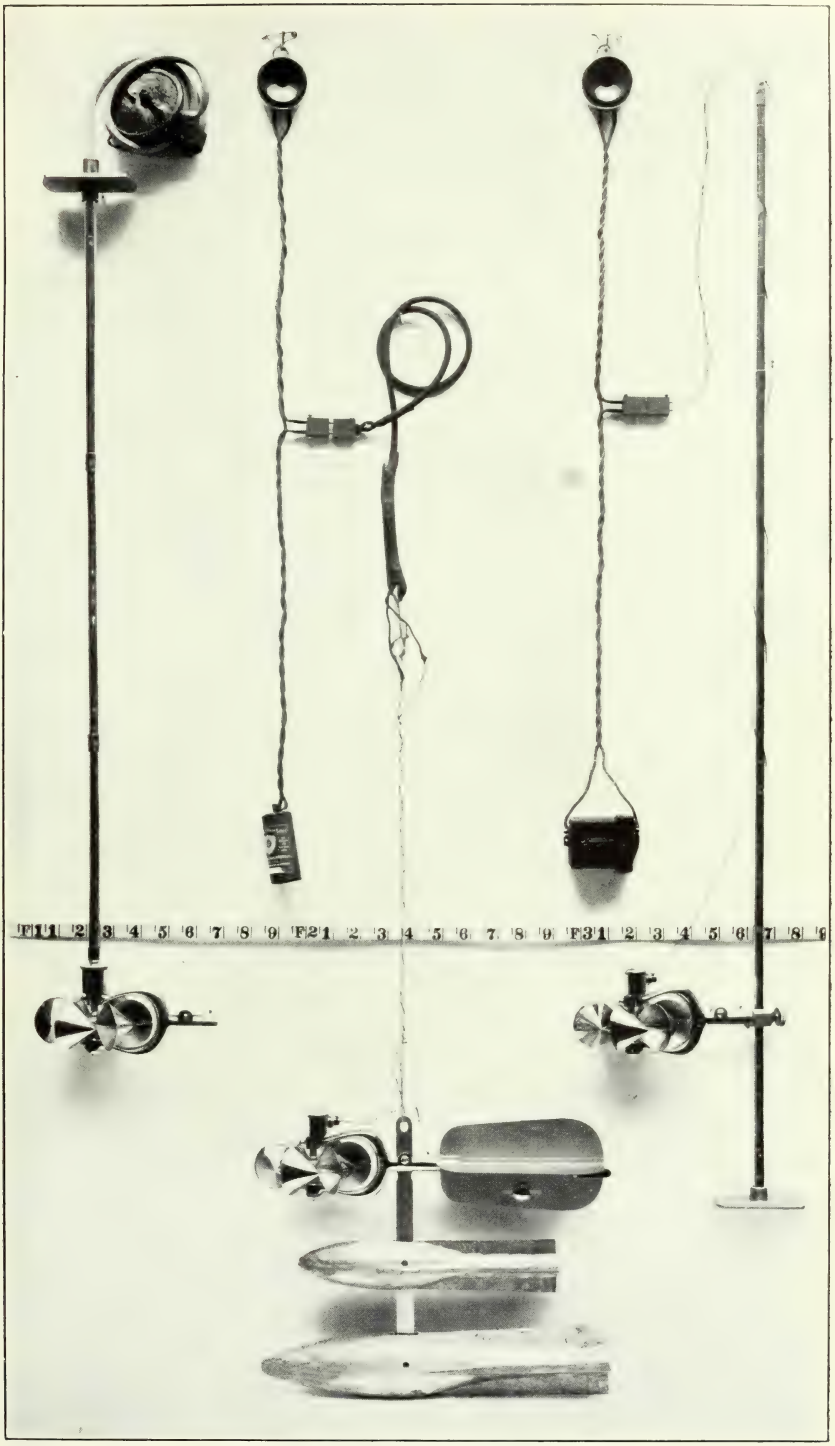
The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A



PRICE PENTA-RECORDING CURRENT METERS.

large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible.

The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are as a rule compara-

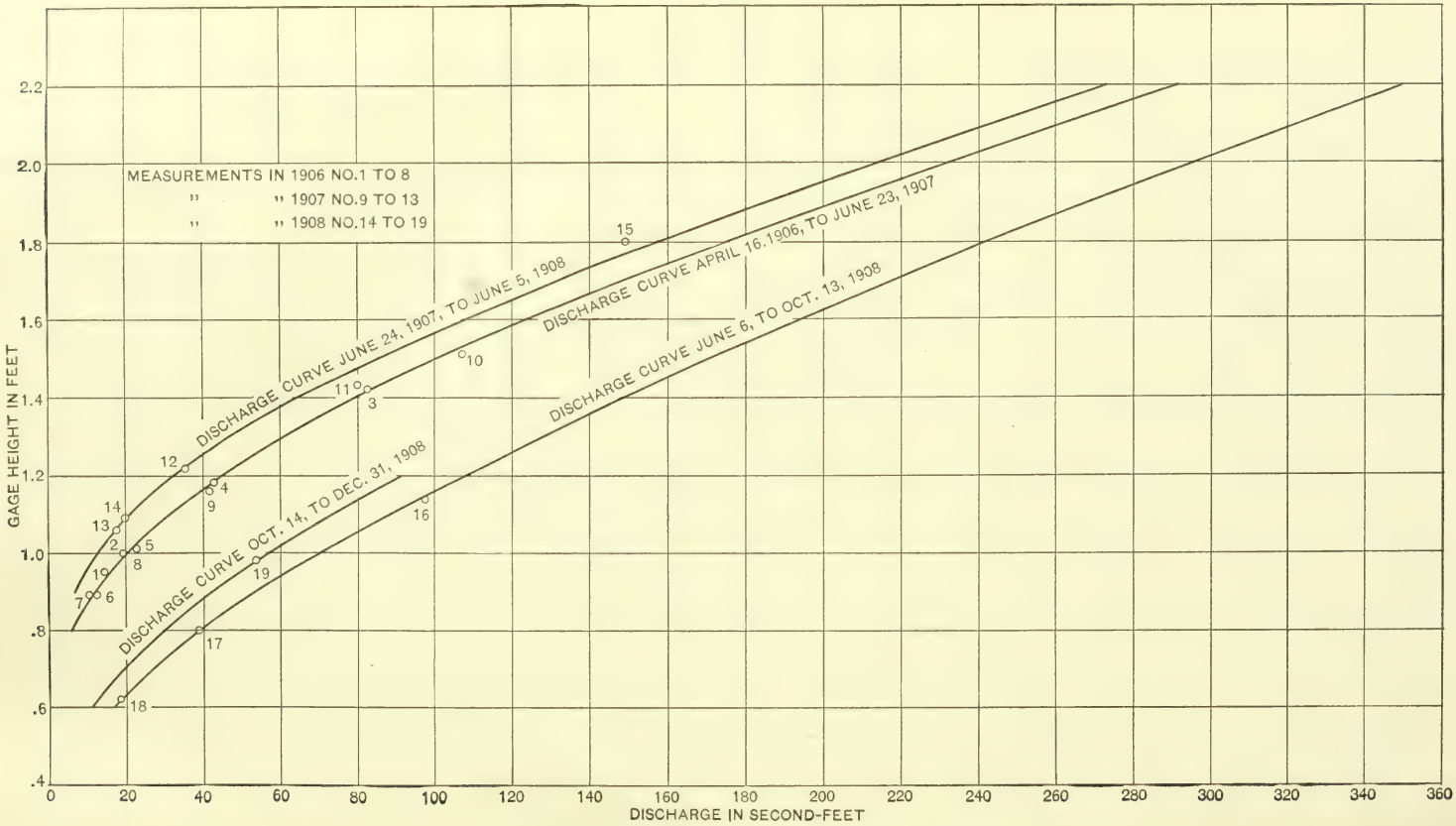


FIGURE 1.—Discharge curves of Smith Creek near Augusta, Mont.

tively permanent during low and medium stages and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class

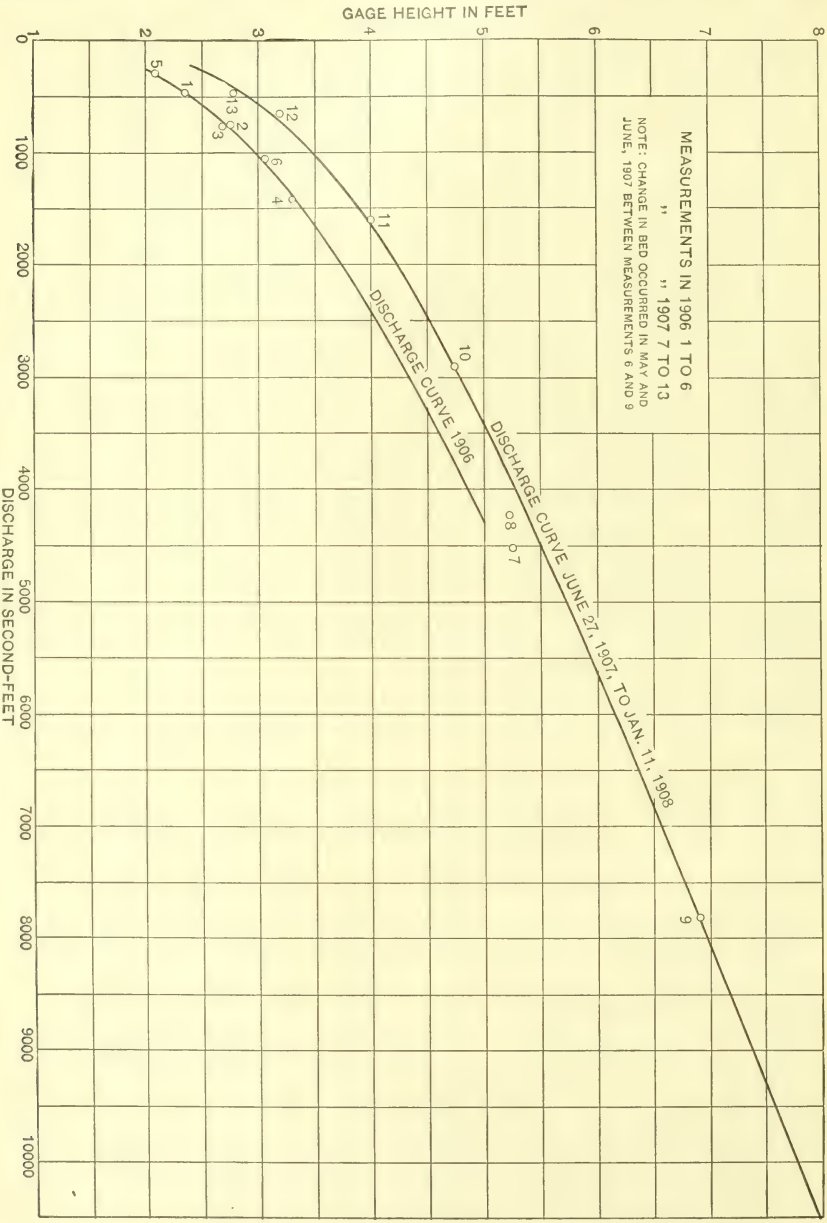


FIGURE 2.—Discharge curves of Marias River near Shelby, Mont.

give nearly as good results as those of class 1. (See figs. 1 and 2.) As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves

before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve, which may be called a standard curve. It has been found in practice that if after a change caused by high stage a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel, which either reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the

velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another, and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abondoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can

alone dictate the course to pursue in such cases. For illustrative example of a station of this type, showing the Bolster method of determining the daily discharge graphically, see Water-Supply Papers 247 and 249.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from

stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly discharge table. In the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or

more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

Assistance has been rendered or records furnished by the following persons or corporations, to whom special acknowledgments are due: Mr. John W. Wade, state engineer of Montana; Mr. T. W. Jaycox, state engineer of Colorado; Mr. Adna Dobson, state engineer of Nebraska; the United States Reclamation Service; the United States Weather Bureau; the United States Forest Service; the Denver Union Water Company; the Central Colorado Power Company; the Denver Reservoir and Irrigation Company; and the Northern Pacific, the Union Pacific, the Great Northern, and the Colorado and Southern railways. Thanks are also here tendered to all other parties and companies who have assisted in the work.

DIVISION OF WORK.

The work in Montana prior to the field season of 1908 was under the charge of Robert Follansbee, district engineer, assisted by J. E. Stewart, assistant engineer, Raymond Richards, and J. B. Pierson. The field data during 1908 were collected under the direction of J. E. Stewart, district engineer, assisted by Raymond Richards and A. F. Huch.

The work in North Dakota was carried on by E. F. Chandler, assistant engineer.

The field data in the South Platte and North Platte drainage areas and in the Bighorn drainage area above the Shoshone were collected under the direction of W. B. Freeman, district engineer, assisted by J. B. Stewart and C. L. Chatfield. This work was in charge of R. I. Meeker, district hydrographer, until May 1, 1908.

Since July 1, 1907, the field work in the Niobrara, Platte, and Kansas river drainage basins in Nebraska has been under the general

supervision of W. B. Freeman, district engineer, but under the immediate direction of Adna Dobson, state engineer, assisted by A. A. Dobson, G. W. Bates, and other employees of the state engineer's office.

The ratings, special estimates, and studies of the completed data were made by Robert Follansbee and J. E. Stewart for Montana, and W. B. Freeman and F. F. Henshaw for Wyoming, Colorado, and Nebraska. The computations and the preparations of the completed data for publication were made by G. C. Stevens, R. C. Rice, J. G. Mathers, H. D. Padgett, and M. I. Walters. The manuscript was edited by Mrs. B. D. Wood.

MISSOURI RIVER DRAINAGE BASIN.

GENERAL FEATURES.

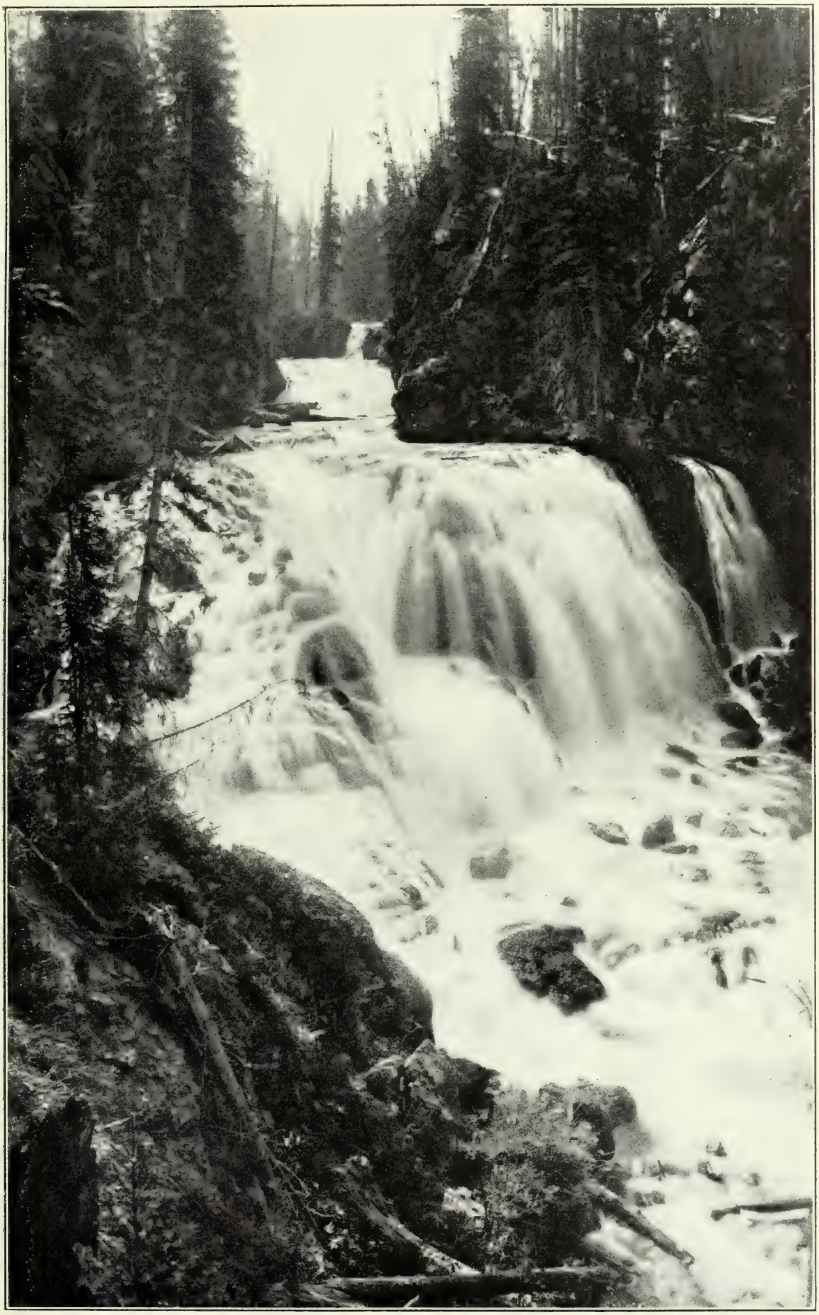
Missouri River and its innumerable tributaries drain an immense area in the northern and western section of the United States. The northern boundary of this area is approximately the fiftieth parallel, the southern the thirty-ninth; to the west it is limited by the Rocky Mountains, while to the east the divide between it and the upper Mississippi basin crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 900 miles; north and south it is 600 miles; and it comprises a total of 492,000 square miles.

The topography of the basin is of the most varied character, ranging from the mountainous regions of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tributaries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of snow, but a great part of the area lies within the arid and semiarid regions, and it is probable that the annual average precipitation throughout the entire basin is less than 20 inches.

The tributaries are mostly in the upper course of the river and from the western side of the basin. The most important of these are Musselshell, Sun, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

Owing to the high altitude and northern climate ice conditions prevail in the upper portions of this basin from November to April. The Missouri itself freezes over entirely, but many of its tributaries remain partly open on account of the extreme rapidity of the water. The amount of snow falling on the prairies is usually small, but among the mountains the snows begin early, continue late, and accumulate to great depths.

Irrigation is practiced to a great extent on the various tributaries of the Missouri and agriculture has been extensively developed in



KEPLER CASCADE, FIREHOLE RIVER, YELLOWSTONE NATIONAL PARK.

many of the valleys. The Madison and Gallatin and many other of the mountain tributaries afford unsurpassed storage facilities, the waters of the Beaverhead, Big Hole, Madison, Jefferson, and Gallatin rivers furnish great supplies for irrigation, and the basins of Milk, Sun, Yellowstone, and Musselshell rivers, already extensively utilized, still offer opportunities for broader irrigation, storage, and water-power development. (See Pls. III and XIII.)

MISSOURI RIVER PROPER.

DESCRIPTION.

Missouri River proper is formed in southwestern Montana by the union of three streams, which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison forks come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies in about latitude 45° 56′ north and longitude 111° 32′ west. Each of the three headwater rivers is about 90 feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three, but the Jefferson drains the largest area, and is here treated as the continuation of the main river. The Jefferson itself is formed by the union of two forks—Big Hole and Beaverhead rivers—the Beaverhead draining the larger area and having as its master headwater stream Red Rock River. The source of this last-named river—the Red Rock lakes, lying in the Rocky Mountains 6,700 feet above sea level—may, therefore, be regarded as the ultimate source of the great Missouri.

Below the junction of the Jefferson, Madison, and Gallatin the course of the Missouri lies through mountain valleys and deep canyons, from which it finally emerges through a gorge in a range of rocks, called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls, and from that point onward it is a navigable stream. For miles below the falls the river flows in a deep canyon, with banks ranging from 100 to 160 feet in height. Below the mouth of Marias River, which enters from the north, the banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, and this remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more to the east across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above

the mouth of the Ohio, and 2,824 miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is a comparatively clear stream, but approximately midway between the forks and the mouth of the Yellowstone its character gradually changes and it becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

Except in the mountain canyons the Missouri flows through an alluvial bottom land of the most fertile character, varying in width from 1½ miles near the mouth to 17 miles in the vicinity of Sioux City.

The volume of Missouri River is subject to great variations, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snows and heavy summer rains. The regular floods occur in May, June, and July, the June discharge being the greatest. Thereafter the river steadily decreases in volume, the minimum being reached during the winter months. Records obtained at Cascade and Townsend indicate 1899 as the wettest year and 1905 as the driest.

The Missouri itself has not been used for irrigation, owing to its high banks and consequent difficulty of diversion. Approximately 150,000 acres of land are now under irrigation in Beaverhead Valley, and by storing the waters of the upper Beaverhead or Red Rock River in Red Rock Lakes fully 125,000 acres more can be put under irrigation.

In Montana the Missouri, with its tributaries, afford many opportunities for power development. A number of large, substantial power stations have been built, and approximately 75,000 horsepower is now being developed. Engineers estimate that 350,000 horsepower can be developed on the Missouri River near Great Falls.

The following gaging stations have been maintained in this river basin:[a]

Red Rock River at Lima, Mont., 1907–8.
Beaverhead River at Barratts, Mont., 1907–8.
Beaverhead River at Dillon, Mont., 1907.
Jefferson River near Sappington, Mont., 1896–1905.
Missouri River near Townsend, Mont., 1895–1904.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1902.
Missouri River at Cascade, Mont., 1902–1908.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River near Williston, N. Dak., 1905–7.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River near Bismarck, N. Dak., 1904–5.
Missouri River at Kansas City, Mo., 1905–6.

[a] Gaging stations in tributary drainage basins are listed under the descriptions of those basins.

RED ROCK RIVER AT LIMA, MONT.

This station, which was established August 14, 1907, to obtain data concerning the amount of water available for irrigation, is located near Gleed ranch, 1 mile east of Lima.

Red Rock River, here regarded as the headwater stream of the Missouri, rises in Red Rock Lakes in the Rocky Mountains 40 miles east of Lima. The tributaries above the station are small and unimportant, the stream at the gaging station receiving its water supply chiefly from the melting snow in the mountains. Below the station Sheep and Sage creeks are the principal tributaries.

Diversions from this stream are many. Above the station 3 ditches, carrying approximately 900 miner's inches each, receive their water supply from the Red Rock. The water is all appropriated above the station, but the rights are unadjudicated. The dam at the reservoir storing the water of the Red Rock has been completed, but the canals are yet to be built. It is an earthen dam with concrete core, is 50 feet high, and has a capacity of 90,000 acre-feet. The dam is 16 miles above Lima, Mont., and 27 miles below Lower Red Rock lakes. Its top elevation is 6,700 feet. This water will be used to irrigate 25,000 acres of land near Lima.

On October 27, 1908, a new chain gage with a new datum was established 300 feet below the old gage. The stream bed is permanent and the results obtained are good. A large spring enters the stream just above the gage and the river remains open the entire year.

Discharge measurements of Red Rock River at Lima, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 14	Robert Follansbee	37	82	1.90	218
August 27	J. E. Stewart	37	76	1.82	181
October 9	Follansbee and Stewart	37	75	1.80	176
1908.					
April 21	Stewart and Richards	42	156	3.50	694
May 15	Raymond Richards	38	117	2.41	369
June 21	do	41	157	3.38	707
August 13	do	36	65	1.49	124
October 27	do	37	80	1.81	213

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Daily gage height, in feet, of Red Rock River at Lima, Mont., for 1907.

[J. L. Lewis and E. R. Gleed, observers.]

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		1.5	1.7	1.8	16	1.9	1.7	1.9	1.7
2		1.5	1.7	1.8	17	1.9	1.7	1.9	1.7
3		1.5	1.8	1.8	18	1.8	1.7	1.9	1.6
4		1.6	1.8	1.8	19	1.5	1.7	1.95	1.8
5		1.6	1.8	1.8	20	1.3	1.7	1.95	1.6
6		1.6	1.8	1.8	21	1.5	1.7	1.95	1.6
7		1.6	1.8	1.8	22	1.4	1.7	1.95	1.7
8		1.6	1.8	1.8	23	1.4	1.7	1.8	1.6
9		1.7	1.8	1.8	24	1.5	1.7	1.8	
10		1.7	1.9	1.85	25	1.6	1.7	1.8	
11		1.7	1.9	1.8	26	1.8	1.7	1.8	
12		1.7	1.9	1.7	27	1.8	1.7	1.8	
13		1.6	1.9	1.6	28	1.8	1.7	1.8	
14	1.9	1.6	1.9	1.8	29	1.8	1.7	1.9	
15	1.9	1.7	1.9	1.7	30	1.9	1.7	1.8	
					31	1.9		1.8	

NOTE.—Ice conditions November 24 to December 31.

Rating table for Red Rock River at Lima, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	25	1.80	191	2.60	421	3.40	689
1.10	43	1.90	216	2.70	453	3.50	724
1.20	62	2.00	242	2.80	485	3.60	759
1.30	81	2.10	269	2.90	518	3.70	794
1.40	101	2.20	297	3.00	552	3.80	829
1.50	122	2.30	327	3.10	586	3.90	864
1.60	144	2.40	357	3.20	620	4.00	900
1.70	167	2.50	389	3.30	654		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during 1907–8 and is fairly well defined.

Monthly discharge of Red Rock River at Lima, Mont., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
August 14–31	216	81	169	6,030	A.
September	167	122	157	9,340	B.
October	229	167	202	12,400	B.
November 1–23	204	144	176	8,030	B.

BEAVERHEAD RIVER AT BARRATTS, MONT.

This station, which was established August 12, 1907, to obtain data for the solution of irrigation problems, is located 1 mile above Barratts and 10 miles southwest of Dillon, Mont.

This stream is called Red Rock River from its source in Red Rock Lakes to the post-office of Red Rock, below which to its junction with Big Hole River it is called the Beaverhead. The principal tributaries to the Beaverhead above the station are Grasshopper

Creek, 12 miles south of Dillon, Horse Prairie Creek, 20 miles south, and Rattlesnake and Blacktail Deer creeks.

Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, ditches constructed in the early seventies being still in operation. Innumerable diversions are made. Decreed water rights aggregating 85,866 inches of water are filed on from Lima on Red Rock River to a point 10 miles above Twin Bridges. The three largest canals diverted below the gaging station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000, and the Beaverhead canal, diverted just north of Dillon, appropriating 5,000 inches. The Union Electric Company, of Dillon, has a canal with a carrying capacity of 6,000 inches.

The stream remains open during the winter months. The gage datum has not been changed. The gaging section has a rocky bottom and should not shift. Records obtained are good.

It is worthy of note that the number and quantity of flow of springs in this valley have increased since irrigation began. The ground evidently serves as a reservoir, the water being absorbed as by a sponge and later coming to the surface as springs.

Discharge measurements of Beaverhead River at Barratts, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 12	Robert Follansbee	71	284	1.94	664
August 27	J. E. Stewart	64	242	1.58	445
October 10	Follansbee and Stewart	64	224	1.20	346
1908.					
April 22	Stewart and Richards	64	296	2.28	930
May 15	Raymond Richards	64	239	1.65	513
June 22	do	94	428	4.72	2,620
August 14	do	60	168	1.63	567
October 27	do	63	196	1.92	769

Daily gage height, in feet, of Beaverhead River at Barratts, Mont., for 1907 and 1908.

[Roy S. Dingley, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1	.....	1.48	1.20	1.50	1.46	16	1.61	1.10	1.42	1.50	1.38
2	.....	1.42	1.24	1.50	1.41	17	1.60	1.12	1.42	1.64	1.08
3	.....	1.38	1.26	1.48	1.32	18	1.52	1.19	1.42	1.60	1.18
4	.....	1.35	1.24	1.45	1.28	19	1.50	1.18	1.42	1.45	1.04
5	.....	1.30	1.22	1.44	1.29	20	1.50	1.15	1.45	1.50	1.10
6	.....	1.29	1.21	1.44	1.28	21	1.45	1.15	1.48	1.60	1.25
7	.....	1.25	1.20	1.46	1.32	22	1.42	1.15	1.45	1.52	.98
8	.....	1.22	1.19	1.48	1.35	23	1.40	1.15	1.45	1.56	1.16
9	.....	1.25	1.18	1.50	1.28	24	1.35	1.15	1.45	1.55	1.16
10	.....	1.22	1.19	1.50	1.38	25	1.38	1.12	1.45	1.65	1.15
11	.....	1.20	1.20	1.50	1.32	26	1.52	1.14	1.45	1.64	1.11
12	1.95	1.18	1.24	1.42	1.35	27	1.58	1.16	1.46	1.46	1.10
13	1.88	1.15	1.26	1.40	1.38	28	1.62	1.16	1.49	1.41	1.11
14	1.78	1.12	1.45	1.44	1.32	29	1.60	1.18	1.50	1.51	1.20
15	1.68	1.12	1.41	1.56	1.30	30	1.55	1.18	1.52	1.49	1.06
						31	1.50	.....	1.51	.....	1.22

Daily gage height, in feet, of Beaverhead River at Barratts, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1.05	0.89	0.89	1.15	1.81	4.85	3.17	1.55	1.45	1.59	2.00	1.41
2	1.21	.78	.95	1.10	1.80	4.35	3.12	1.54	1.40	1.65	2.00	1.45
3	1.05	.85	.96	1.35	1.80	4.85	3.11	1.51	1.40	1.88	1.98	1.42
4	1.12	.88	.96	1.42	1.95	4.95	3.07	1.50	1.35	1.88	1.92	1.42
5	1.18	.82	1.04	1.45	1.90	4.30	3.01	1.48	1.30	1.90	1.85	1.50
6	1.05	.81	1.00	1.45	1.80	4.20	2.96	1.45	1.30	1.88	1.85	1.50
7	1.15	.80	.99	1.42	1.70	4.40	2.77	1.45	1.28	1.85	1.85	1.50
8	1.15	.86	.99	1.38	1.60	4.70	2.56	1.42	1.26	1.88	1.85	1.49
9	1.06	.88	.98	1.40	1.65	4.80	2.43	1.40	1.25	1.85	1.88	1.50
10	.98	.86	.99	1.52	1.90	4.88	2.30	1.40	1.25	1.80	1.82	1.52
11	1.20	.90	1.00	1.70	2.22	5.15	2.15	1.40	1.25	1.80	1.55	1.45
12	1.02	.90	1.05	1.85	2.25	5.00	2.08	1.40	1.38	1.80	1.48	1.48
13	1.06	.86	1.08	2.00	1.85	5.00	2.09	1.40	1.38	1.90	1.55	1.50
14	1.05	.92	1.09	2.06	1.88	4.95	2.05	1.50	1.35	1.85	1.58	1.38
15	1.06	.92	1.30	2.04	1.66	4.90	2.00	1.72	1.35	1.90	1.65	1.28
16	1.00	.91	1.55	2.12	1.50	4.90	2.00	1.68	1.35	1.90	1.65	1.25
17	.95	.90	1.72	2.20	1.50	5.70	1.92	1.58	1.45	2.00	1.65	1.40
18	.94	.88	1.40	2.20	1.38	5.85	1.78	1.55	1.58	2.00	1.70	1.42
19	.95	.88	1.30	2.15	1.45	6.00	1.78	1.55	1.58	1.90	1.82	1.50
20	.96	.85	1.25	2.36	2.20	6.00	1.75	1.58	1.55	1.95	1.85	1.68
21	.95	.89	1.25	2.30	1.75	4.85	1.75	1.55	1.50	1.80	1.90	1.75
22	.98	.88	.98	2.28	1.58	4.65	1.75	1.58	1.50	1.82	1.82	1.90
23	1.05	.89	1.40	2.32	1.50	4.58	1.80	1.60	1.48	1.95	1.60	2.12
24	1.09	.90	1.30	2.32	1.40	4.46	1.70	1.55	1.48	2.00	1.80	2.08
25	1.02	.92	1.32	2.28	1.40	4.15	1.68	1.52	1.58	2.01	1.80	1.88
26	1.00	.89	1.28	2.20	2.40	3.92	1.68	1.46	1.60	2.08	1.55	1.70
27	.98	.90	1.35	2.15	3.75	3.70	1.65	1.45	1.65	2.00	1.40	1.35
28	.98	1.00	1.20	2.10	3.60	3.70	1.55	1.45	1.65	1.98	1.40	1.19
29	.98	1.00	1.15	2.02	3.05	3.68	1.55	1.45	1.60	2.00	1.35	1.20
30	1.00	.....	1.26	1.95	3.70	3.50	1.55	1.45	1.58	2.00	1.40	1.28
31	1.03	.....	1.30	.....	5.10	.....	1.55	1.45	.....	2.00	.....	1.32

Rating tables for Beaverhead River at Barratts, Mont.

AUGUST 12, 1907, TO MAY 20, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	262	1.30	374	1.80	561	2.30	868
.90	280	1.40	404	1.90	612	2.40	936
1.00	300	1.50	437	2.00	669		
1.10	322	1.60	474	2.10	732		
1.20	347	1.70	515	2.20	800		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during this period and is fairly well defined.

MAY 21 TO DECEMBER 31, 1908.

1.00	360	2.10	820	3.20	1,500	4.60	2,520
1.10	385	2.20	875	3.30	1,570	4.80	2,680
1.20	415	2.30	930	3.40	1,640	5.00	2,840
1.30	450	2.40	990	3.50	1,710	5.20	3,000
1.40	487	2.50	1,050	3.60	1,780	5.40	3,160
1.50	528	2.60	1,110	3.70	1,850	5.60	3,320
1.60	573	2.70	1,175	3.80	1,920	5.80	3,480
1.70	618	2.80	1,240	3.90	1,990	6.00	3,640
1.80	665	2.90	1,305	4.00	2,065		
1.90	715	3.00	1,370	4.20	2,215		
2.00	765	3.10	1,435	4.40	2,365		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and is not well defined. Above gage height 2.5 feet the rating curve depends on one measurement made at gage height 4.7 feet.

Monthly discharge of Beaverhead River at Barratts, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 12–31	640	389	468	18,600	A.
September	430	322	350	20,800	A.
October	444	342	393	24,200	A.
November	494	404	440	26,200	A.
December	424	296	358	22,000	B.
1908.					
January	350	288	309	19,000	B.
February	300	259	277	15,900	B.
March	524	278	345	21,200	B.
April	909	322	637	37,900	A.
May	2,920	398	805	49,500	A.
June	3,640	1,710	2,610	155,000	A.
July	1,480	550	865	53,200	A.
August	627	487	530	32,600	A.
September	596	432	505	30,000	A.
October	809	568	714	43,900	A.
November	765	468	629	37,400	A.
December	831	412	539	33,100	B.
The year	3,640	259	730	529,000	

BEAVERHEAD RIVER AT DILLON, MONT.

This station, which was established August 28, 1907, is located at the highway bridge on the Bannock Road, three-quarters of a mile from Dillon, Mont. It was discontinued December 31, 1907.

The river at this point flows in two channels. The left channel is the source of supply of a canal which heads a short distance below the bridge, and its flow is controlled by the canal head gates. To determine the total flow of the stream both the right and left channels must be measured. The following gage heights and discharge measurements refer to the right channel only.

Discharge measurements of Beaverhead River at Dillon, Mont., in 1907.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
August 28	J. E. Stewart	172	3.15	[a] 287
October 10	Follansbee and Stewart	181	3.40	[a] 306

[a] Exclusive of amount in canal approach.

Daily gage height, in feet, of Beaverhead River at Dillon, Mont., for 1907.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		3.25	11		3.1	21		3.4
2		3.25	12		3.1	22		3.4
3		3.25	13		3.1	23		3.4
4		3.4	14		3.2	24		3.4
5		3.3	15		3.2	25		3.4
6		3.3	16		3.2	26		3.4
7		3.2	17		3.25	27		3.4
8		3.2	18		3.3	28	3.1	3.4
9		3.2	19		3.4	29	3.05	3.4
10		3.1	20		3.4	30	3.0	3.4
						31	3.2	

MISSOURI RIVER AT CASCADE, MONT.

This station, which was established July 20, 1902, to obtain records for use in connection with irrigation, power development, and for general statistical purposes, is located on the highway bridge on the east side of the town of Cascade, Mont., 100 yards from the Great Northern Railway.

The Missouri receives many tributaries above the station, the most important being Dearborn River, Wolf Creek, and Prickly Pear Creek; within a hundred miles below, Sun and Marias rivers enter. The drainage area at the station is 18,300 square miles.

Although irrigation is extensively developed in the Missouri River Valley, the water supply is obtained from the tributary streams, its high banks, great variation in flow, and difficulty in diversion causing the Missouri itself to be little used.

The datum of the standard gage chain used at this station has remained unchanged.

Records obtained have been very good, the channel being permanent except in extreme floods. Gage heights are affected by ice during the winter months.

Discharge measurements of Missouri River at Cascade, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 5	J. E. Stewart	370	3,070	5.29	6,170
May 10	do	374	3,150	5.44	6,560
June 5	do	473	4,330	8.20	15,700
July 8	do	475	5,180	10.05	25,000
August 23	do	350	2,650	4.14	3,000
November 7	do	375	3,000	5.24	5,940
1908.					
May 25	Raymond Richards	373	3,410	6.38	9,120
June 22	J. E. Stewart	481	6,700	12.90	[a] 36,500
July 6	Raymond Richards	456	4,830	9.27	[b] 20,300
September 2	do	363	3,050	4.72	3,750
October 20	do	378	3,600	6.18	[b] 7,490

[a] Area partly computed from soundings of September 2, 1908.
[b] Area computed from soundings of September 2, 1908.

Daily gage height, in feet, of Missouri River at Cascade, Mont., for 1907 and 1908.

[Frank Warner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1			5.88	5.08	5.70	7.75	10.95	6.90	4.60	4.60	4.70	4.70
2			5.78	5.15	5.50	7.90	10.75	6.80	4.60	4.60	4.80	4.70
3			5.68	5.22	5.50	7.80	10.60	6.05	4.70	4.60	5.00	4.30
4			5.45	5.28	5.62	7.92	10.30	6.40	5.00	4.60	4.90	4.20
5			5.32	5.30	5.75	8.18	10.00	6.35	4.90	4.70	4.50	4.30
6			5.22	5.25	5.30	8.25	10.30	6.25	4.80	5.00	3.90	4.40
7			5.12	5.20	5.42	8.40	10.25	5.10	4.70	5.00	4.85	4.50
8			5.02	5.20	5.65	8.60	10.05	5.35	4.80	5.00	4.85	4.60
9			4.92	5.25	5.42	8.80	9.80	5.60	4.70	5.00	4.50	4.60
10			4.90	5.25	5.42	8.95	9.40	5.80	4.60	5.00	4.10	4.50
11			4.90	5.28	5.55	9.15	9.05	5.80	4.60	4.90	3.80	4.50
12			4.95	5.30	5.65	9.45	8.65	5.80	4.70	4.90	4.00	4.50
13			4.98	5.30	5.50	9.35	7.40	5.50	4.70	4.80	4.50	4.50
14			5.00	5.30	5.98	9.15	7.65	5.70	4.70	4.70	5.20	4.50
15			5.08	5.60	6.40	9.30	7.95	5.50	4.80	4.70	4.90	4.50
16			5.10	6.05	6.58	9.15	8.05	5.50	4.70	4.70	4.50	4.50
17			5.18	6.10	6.55	9.00	8.35	5.50	4.70	4.70	4.00	4.60
18			5.22	6.32	6.60	8.90	8.55	4.95	4.70	4.70	3.80	4.80
19			5.32	6.30	6.60	8.75	8.60	4.75	4.60	4.70	4.30	.....
20			5.42	6.58	6.80	8.45	8.60	4.10	4.65	4.75	5.00	.....
21			5.55	6.40	7.20	8.15	8.80	4.10	4.70	5.20	4.80	.....
22		6.25	5.68	6.25	7.85	7.90	8.50	4.50	4.60	5.70	4.50	.....
23		6.50	5.70	6.05	8.05	11.25	7.60	4.20	4.60	5.60	4.10	.....
24		6.38	5.58	6.05	8.22	12.55	7.95	4.20	4.60	4.85	4.10	.....
25		6.28	5.48	6.00	8.35	11.85	7.30	4.20	4.60	4.65	4.40	.....
26		6.18	5.38	5.95	8.35	11.90	6.65	4.20	4.60	4.10	4.70	.....
27		6.08	5.28	5.85	8.10	11.65	7.10	4.20	4.60	3.80	5.00	.....
28		5.98	5.18	5.85	7.90	11.65	7.20	4.25	4.60	4.25	4.70	.....
29		.....	5.05	5.80	7.90	11.70	7.20	4.25	4.60	4.45	4.20	.....
30		.....	5.05	5.78	7.75	11.35	7.10	4.75	4.60	4.60	4.30	.....
31		.....	5.05	.....	7.50	.....	7.00	4.70	.....	4.60	.....	.....
1908.												
1	5.95	6.30	4.60	4.50	5.50	10.45	10.10	5.25	4.70	5.05	5.70	5.85
2	5.80	6.20	4.50	4.60	5.50	11.50	9.65	4.95	4.70	5.35	5.70	6.05
3	5.60	6.00	4.60	4.50	5.50	11.70	9.20	4.80	4.70	5.50	5.60	6.40
4	5.60	5.80	4.60	4.40	5.40	13.15	9.20	4.80	4.70	5.50	5.60	6.40
5	5.70	5.25	4.60	4.40	5.40	15.45	9.20	4.95	4.70	5.50	5.60	6.50
6	6.05	5.00	4.50	4.40	5.40	15.60	9.20	5.15	4.70	5.50	5.60	7.05
7	6.20	5.10	4.50	4.25	5.50	14.60	9.10	4.90	4.70	5.50	5.50	7.40
8	6.30	5.10	4.50	4.30	5.60	14.25	8.75	4.90	4.70	5.60	5.50	7.50
9	6.40	5.00	4.40	4.50	5.80	14.15	8.50	4.80	4.70	5.60	5.40	7.50
10	6.40	5.10	4.40	4.50	5.90	13.95	8.10	4.70	4.70	5.50	5.40	7.50
11	6.40	5.20	4.50	4.50	6.40	13.85	7.60	4.60	4.70	5.50	5.40	7.20
12	6.40	5.30	4.60	4.40	6.85	13.65	7.35	4.40	4.55	5.50	5.30	7.05
13	6.40	5.45	4.70	4.40	6.95	13.50	7.20	4.30	4.50	5.50	5.30	6.85
14	6.40	5.60	4.80	4.50	6.70	13.40	7.20	4.30	4.60	5.55	5.20	6.35
15	6.40	6.00	4.95	11.48	6.45	13.40	6.90	4.45	4.70	5.60	5.20	6.15
16	6.40	6.40	5.00	6.20	6.25	13.40	6.90	4.60	4.70	5.60	5.20	6.00
17	6.40	6.50	4.60	6.00	6.05	13.40	7.00	4.60	4.70	5.60	5.30	5.70
18	6.30	6.10	4.45	6.00	5.90	13.30	7.10	4.60	4.90	5.80	5.30	5.30
19	6.30	6.00	4.15	6.00	6.00	13.30	6.95	4.60	4.95	6.20	5.40	5.20
20	6.30	5.70	4.20	6.30	6.00	13.30	6.75	4.60	5.30	6.10	5.50	5.45
21	6.30	5.60	4.70	6.30	6.00	13.15	6.55	4.90	5.20	6.00	5.50	6.05
22	6.20	5.40	5.00	6.05	6.10	12.85	6.30	4.95	5.20	5.90	5.50	6.10
23	6.20	4.90	3.50	6.10	6.10	12.60	6.30	4.80	5.10	5.60	5.50	6.00
24	6.30	4.40	3.35	6.00	6.20	12.15	6.25	4.70	5.10	5.60	5.50	5.90
25	6.30	4.45	4.40	6.00	6.30	11.60	6.10	4.70	5.00	5.60	5.50	6.00
26	6.40	4.55	4.40	5.95	6.40	10.90	5.95	4.70	5.00	5.60	5.50	5.80
27	6.40	4.60	4.40	5.90	7.65	10.40	5.70	4.70	4.90	5.70	5.50	5.70
28	6.40	4.50	4.10	6.05	8.40	10.25	5.70	4.70	4.90	5.70	5.60	5.50
29	6.40	4.60	4.00	5.80	8.40	10.35	5.70	4.90	4.90	5.70	5.70	5.60
30	6.40	.....	4.20	5.50	8.50	10.25	5.55	4.70	4.85	5.70	5.70	6.00
31	6.40	.....	4.40	.....	9.05	.....	5.35	4.70	.....	5.70	.....	6.00

NOTE.—Ice conditions January 1–February 20, and December, 1907; January, February, and March, and December 19–31, 1908. The river was open January 11 and February 23, 1908.

Rating tables for Missouri River at Cascade, Mont.

JANUARY 1, 1907, TO APRIL 15, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	1,900	4.90	4,930	6.30	9,400	8.40	17,640
3.60	2,040	5.00	5,210	6.40	9,750	8.60	18,480
3.70	2,190	5.10	5,500	6.50	10,110	8.80	19,320
3.80	2,350	5.20	5,800	6.60	10,470	9.00	20,170
3.90	2,520	5.30	6,100	6.70	10,840	9.20	21,030
4.00	2,700	5.40	6,410	6.80	11,210	9.40	21,890
4.10	2,910	5.50	6,720	6.90	11,590	9.60	22,750
4.20	3,130	5.60	7,040	7.00	11,970	9.80	23,620
4.30	3,360	5.70	7,360	7.20	12,730	10.00	24,500
4.40	3,600	5.80	7,690	7.40	13,500	11.00	28,950
4.50	3,850	5.90	8,020	7.60	14,300	12.00	33,450
4.60	4,110	6.00	8,360	7.80	15,120		
4.70	4,380	6.10	8,700	8.00	15,960		
4.80	4,650	6.20	9,050	8.20	16,800		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907 and is well defined between gage heights 4.0 feet and 10.0 feet.

APRIL 16 TO DECEMBER 31, 1908.

3.30	1,310	4.90	4,230	6.50	9,220	9.20	20,500
3.40	1,400	5.00	4,500	6.60	9,580	9.40	21,400
3.50	1,500	5.10	4,770	6.70	9,950	9.60	22,300
3.60	1,610	5.20	5,050	6.80	10,330	9.80	23,200
3.70	1,740	5.30	5,340	6.90	10,710	10.00	24,100
3.80	1,880	5.40	5,630	7.00	11,100	10.20	25,000
3.90	2,040	5.50	5,930	7.20	11,890	10.40	25,900
4.00	2,210	5.60	6,230	7.40	12,700	10.60	26,800
4.10	2,390	5.70	6,530	7.60	13,520	10.80	27,700
4.20	2,580	5.80	6,850	7.80	14,360	11.00	28,600
4.30	2,780	5.90	7,170	8.00	15,200	12.00	33,100
4.40	3,000	6.00	7,500	8.20	16,060	13.00	37,600
4.50	3,230	6.10	7,830	8.40	16,930	14.00	42,100
4.60	3,470	6.20	8,170	8.60	17,810	15.00	46,600
4.70	3,720	6.30	8,510	8.80	18,700	16.00	51,100
4.80	3,970	6.40	8,860	9.00	19,600		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and high-water measurements of previous years, and is fairly well defined above gage height 4.5 feet. Below 4.5 feet the rating is somewhat uncertain. Above gage height 9.0 feet the curve is a tangent, the difference being 450 per tenth.

Monthly discharge of Missouri River at Cascade, Mont., for 1907 and 1908.

[Drainage area, 18,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March	7,950	4,930	6,040	0.330	0.38	371,000	A.
April	10,400	5,440	7,320	.400	.45	436,000	A.
May	17,400	6,100	10,700	.585	.67	658,000	A.
June	36,000	14,900	22,200	1.21	1.35	1,320,000	A.
July	28,700	10,800	18,700	1.02	1.18	1,150,000	A.
August	11,600	2,910	6,010	.328	.38	370,000	A.
September	5,210	4,110	4,320	.236	.26	257,000	A.
October	7,360	2,350	4,580	.250	.29	282,000	A.
November	5,800	2,350	3,910	.214	.24	233,000	A.
December	.....	.....	[a] 3,500	.191	.22	215,000	A.
The period	.....	.....	.....	.....	.....	5,290,000	
1908.							
April	31,100	3,240	6,530	.357	.40	389,000	A.
May	19,800	5,630	9,090	.497	.57	559,000	A.
June	49,300	25,200	36,700	2.01	2.24	2,180,000	A.
July	24,600	5,480	12,800	.699	.81	787,000	A.
August	5,200	2,780	3,810	.208	.24	234,000	A.
September	5,340	3,230	4,050	.221	.25	241,000	A.
October	8,170	4,640	6,320	.345	.40	389,000	A.
November	6,530	5,050	5,850	.320	.36	348,000	A.
The period	.....	.....	.....	.....	.....	5,130,000	

[a] Estimated.

MISSOURI RIVER NEAR WILLISTON, N. DAK.

This station, which is located at Bakers Ferry, 10 miles down the river from Williston, N. Dak., and 13½ miles southeast by the main traveled road on the east side of the river from Williston ferry landing, was established April 24, 1905, for the purpose of obtaining general information concerning run-off. It was discontinued May 23, 1907.

Yellowstone River, which enters the Missouri about 20 miles above the station, is the nearest important tributary. The drainage area above this point includes the entire basin of the Missouri in Montana and northern Wyoming.

Discharge measurements of Missouri River near Williston, N. Dak., in 1905 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 24	E. F. Chandler	525	4,480	5.26	10,400
May 22	Chandler and Richards	507	4,540	6.58	12,600
June 21	P. M. Churchill	787	13,300	12.20	69,500
July 10	....do	770	11,700	11.10	58,000
August 14	....do	753	5,920	6.78	14,900
September 19	Chandler and Fellows	435	2,700	4.41	6,780
1908.					
June 20	E. F. Chandler	885	[a] 19,800	19.49	147,000

[a] Approximate.

Daily gage height, in feet, of Missouri River near Williston, N. Dak., for 1907.

[G. E. Baker, observer.]

Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.
1	14.0	14.7	10.4	11	11.2	11.7	9.9	21	11.3	10.9	11.3
2	13.9	14.8	10.3	12	11.2	12.2	10.0	22	11.5	10.8	11.4
3	13.5	15.4	10.2	13	11.25	11.7	10.1	23	12.9	10.75	.....
4	13.1	15.9	10.0	14	11.25	11.5	10.0	24	14.4	10.7	.....
5	12.9	15.9	10.0	15	11.3	11.6	10.3	25	16.0	10.9	.....
6	12.6	12.5	10.1	16	11.3	11.6	10.8	26	17.3	11.0	.....
7	12.3	13.1	10.0	17	11.1	11.4	11.0	27	16.8	11.0	.....
8	12.0	12.2	9.9	18	10.9	11.2	11.0	28	16.5	10.9	.....
9	11.9	12.0	9.8	19	11.0	11.1	11.1	29	16.4	10.6	.....
10	11.4	11.8	9.8	20	11.1	11.0	11.2	30	16.0	10.4	.....
								31	15.2	.....	.....

Rating table for Missouri River near Williston, N. Dak., for 1905–1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	6,000	5.50	9,500	7.09	16,900	9.80	43,900
4.10	6,200	5.60	9,830	7.20	18,480	10.00	46,000
4.20	6,400	5.70	10,170	7.40	20,080	11.00	56,500
4.30	6,600	5.80	10,540	7.60	21,750	12.00	67,000
4.40	6,800	5.90	10,910	7.80	23,520	13.00	77,500
4.50	7,000	6.00	11,300	8.00	25,400	14.00	88,000
4.60	7,220	6.10	11,700	8.20	27,400	15.00	99,000
4.70	7,440	6.20	12,150	8.40	29,400	16.00	110,000
4.80	7,660	6.30	12,620	8.60	31,420	17.00	121,000
4.90	7,880	6.40	13,120	8.80	33,460	18.00	132,000
5.00	8,100	6.50	13,650	9.00	35,500	19.00	143,000
5.10	8,340	6.60	14,200	9.20	37,600	20.00	154,000
5.20	8,600	6.70	14,800	9.40	39,700	21.00	165,000
5.30	8,880	6.80	15,450	9.60	41,800	22.00	176,000
5.40	9,180	6.90	16,150				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1905 and one flood measurement made June 20, 1908, and is not well defined. Above gage height 14.0 feet the rating curve is a tangent, the difference being 1,100 per tenth.

Monthly discharge of Missouri River near Williston, N. Dak., for 1905–1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
May 23–31	40,800	14,800	30,200	539,000	C.
June	83,800	38,600	68,100	4,050,000	C.
July	73,300	34,500	54,900	3,380,000	C.
August	43,900	7,880	19,400	1,190,000	C.
September	7,880	6,000	7,100	422,000	C.
October	9,830	6,400	7,700	473,000	D.
November	8,600	7,220	8,060	480,000	D.
The period				10,500,000	
1906.					
May 26–31	90,200	73,300	82,800	985,000	C.
June	155,000	61,800	93,600	5,570,000	C.
July	74,400	36,600	52,700	3,240,000	C.
August	45,000	13,100	25,200	1,550,000	C.
September	25,400	10,500	15,400	916,000	D.
October	10,200	8,340	8,840	544,000	D.
November 1–24	23,500	8,600	10,100	481,000	D.
The period				13,300,000	
1907.					
March	124,000	55,400	77,900	4,790,000	C.
April	109,000	50,200	67,500	4,020,000	C.
May 1–22	60,700	43,900	50,100	2,190,000	C.

PRICKLY PEAR CREEK DRAINAGE BASIN.

DESCRIPTION.

Prickly Pear Creek rises in the mountains in the northwestern part of Jefferson County, Mont., and takes a general northeasterly course to its junction with the Missouri near Eldorado bar in the southeastern part of Lewis and Clark County. Its principal tributaries are McClellan, Lump Gulch, Tenmile, and Silver creeks. Its upper valley is narrow and little irrigation is practiced, but below Helena the entire normal flow is diverted for irrigation.

The following gaging stations have been maintained in this basin:

Prickly Pear Creek near Clancy, Mont., 1908.
Prickly Pear Creek at East Helena, Mont., 1908.
Lump Gulch Creek near Clancy, Mont., 1908.
Tenmile Creek near Helena, Mont., 1908.
Sevenmile Creek near Helena, Mont., 1908.

PRICKLY PEAR CREEK NEAR CLANCY, MONT.

This station, which was established July 15, 1908, to obtain data for use in connection with irrigation projects, is located about 2 miles below Clancy and 12 miles south of Helena, and is directly west of the house of the observer.

Lump Gulch Creek enters about a mile above the station, and McClellan Creek comes in between the station and East Helena. Owing to the very narrow valley and the small amount of irrigable land above the station, little water is diverted for irrigation.

The stream bed is of gravel and sand and shifts. Gage heights are affected by ice during the winter months and the records obtained are unsatisfactory.

The greatest flood experienced in this valley for many years is probably that of June, 1908.

Discharge measurements of Prickly Pear Creek near Clancy, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 15	J. E. Stewart	30	45.2	1.86	96.8
August 10	Raymond Richards	26	21.6	.89	[a] 40.1
October 10	do	32	42.5	1.79	79.9

[a] Meter in poor condition; discharge considered small.

Daily gage height, in feet, of Prickly Pear Creek near Clancy, Mont., for 1908.

[John Gillis, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					1.0	1.4	16	1.85			1.6	2.0	1.2
2					1.0	1.4	17	1.8			1.6	2.4	1.2
3					1.0	1.4	18	1.7			1.4	1.9	1.2
4					1.9	1.4	19	1.65			1.4	1.9	1.0
5					1.9	1.2	20	1.55			1.9	1.7	1.5
6					1.9	1.2	21	1.5			1.9	1.7	1.5
7					1.5	1.2	22	1.4			1.9	1.8	1.5
8					1.9	1.2	23	1.6			1.4	1.8	1.2
9					1.9	1.0	24	1.5			1.4	1.8	1.2
10				1.8	1.7	1.0	25	1.4			2.0	1.8	1.2
11				1.8	1.7	1.9	26				2.0	1.6	1.0
12				1.8	1.7	1.9	27				2.0	1.6	1.9
13				1.8	1.5	1.3	28				1.7	1.6	1.9
14				1.8	1.5	1.2	29				1.7	1.2	1.8
15	1.85			1.6	2.4	1.3	30				1.7	1.2	1.7
							31				1.6		1.6

PRICKLY PEAR CREEK AT EAST HELENA, MONT.

This station, which was established July 18, 1908, to obtain data for use in irrigation development, is located where the Northern Pacific Railway crosses the stream at East Helena, Mont.

McClellan and Lump Gulch creeks are the only important tributaries entering above the station; Tenmile and Silver creeks come in below. All the normal flow of this stream is used for irrigation, the greater part of the water being diverted below this station.

At the gaging section the channel is rocky, clean, and nonshifting. The bed of the stream is so extremely rough that even in low water measurements are difficult. Fair results, however, have been obtained.

Discharge measurements of Prickly Pear Creek at East Helena, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 18	Raymond Richards	33	37.0	1.49	104
August 11	do	28.5	20.2	1.19	[a] 51.9
October 10	do	32	36.2	1.39	101

[a] Meter in poor condition; discharge considered small.

Daily gage height, in feet, of Prickly Pear Creek at East Helena, Mont., for 1908.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.1	1.1	1.1	1.3	1.2	16	.....	1.2	1.1	1.6	1.0	.....
2	.....	1.1	1.1	1.2	1.3	1.2	17	.....	1.1	1.1	1.6	1.2	.....
3	.....	1.1	1.1	1.4	1.3	1.1	18	.....	1.1	1.1	1.4	1.3	.....
4	.....	1.1	1.1	1.4	1.3	1.0	19	1.4	1.1	1.1	1.4	1.2	.....
5	.....	1.1	1.1	1.4	1.3	1.0	20	1.4	1.2	1.1	1.4	1.2	.....
6	.....	1.1	1.1	1.4	1.3	.....	21	1.4	1.1	1.1	1.4	1.2	.....
7	.....	1.1	1.1	1.4	1.3	.....	22	1.4	1.1	1.2	1.3	1.2	.....
8	.....	1.1	1.1	1.4	1.3	.....	23	1.4	1.1	1.1	1.3	1.2	.....
9	.....	1.1	1.1	1.4	1.3	.....	24	1.5	1.0	1.1	1.3	1.1	.....
10	.....	1.1	1.1	1.4	1.3	.....	25	1.3	.9	1.0	1.3	1.1	.....
11	.....	1.1	1.1	1.4	1.1	.....	26	1.3	1.0	1.0	1.3	1.1	.....
12	.....	1.1	1.1	1.4	1.0	.....	27	1.3	1.1	1.0	1.3	1.2	.....
13	.....	1.2	1.1	1.4	.9	.....	28	1.2	1.1	1.0	1.3	1.2	.....
14	.....	1.4	1.1	1.4	1.0	.....	29	1.2	1.1	1.0	1.3	1.1	.....
15	.....	1.2	1.1	1.4	1.0	.....	30	1.2	1.1	1.1	1.3	1.1	.....
							31	1.1	1.1	.....	1.3	.....	.....

LUMP GULCH CREEK NEAR CLANCY, MONT.

Lump Gulch Creek, a small mountain stream with no important tributaries, has been quite extensively used for placer mining, and many diversions were made for that purpose. At present some irrigation is practiced, but the valley is narrow and affords but little irrigable land. The normal flow of the stream is appropriated.

The gaging station, which was established July 15, 1908, to obtain information concerning the amount of water available for storage and for irrigation, is located at the ranch of Charles Zastrow, 1 mile from Clancy, 15 miles from Helena, and one-half mile above the stream's junction with Prickly Pear Creek.

The stream bed is gravelly, unclean, and shifting, making it difficult to obtain satisfactory data. Gage heights are affected by ice. No flood records have been obtained.

Discharge measurements of Lump Gulch Creek at Clancy, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 15	J. E. Stewart	10.7	12.6	1.30	21.0
August 10	Raymond Richards	6.0	2.9	.75	3.9
October 10	....do	12.5	9.2	1.22	17.2

Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1908.

[Charles Zastrow, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.95	0.85	0.95	1.1	16	1.3	0.85	0.85	1.10	1.05
2	.....	.95	.85	1.05	1.1	17	1.3	.8	.95	1.10	1.1
3	.....	.9	.85	1.01	1.1	18	1.25	.8	.95	1.10	1.1
4	.....	.85	.8	1.01	1.05	19	1.15	.8	.95	1.10	1.1
5	.....	.8	.8	1.02	1.05	20	1.15	.85	1.0	1.10	1.1
6	.....	.8	.75	1.02	1.05	21	1.15	.85	1.0	1.10	1.1
7	.....	.8	.75	1.02	1.05	22	1.1	.85	1.0	1.10	1.05
9	.....	.75	.8	1.02	1.05	23	1.1	.9	1.0	1.10	1.05
9	.....	.75	.8	1.02	1.05	24	1.15	.85	1.0	1.10	1.05
10	.....	.75	.8	1.25	1.05	25	1.15	.85	1.0	1.10	1.05
11	.....	.7	.8	1.15	1.05	26	1.15	.85	1.0	1.10	1.05
12	.....	.7	.8	1.15	1.05	27	1.15	.85	1.0	1.10	1.05
13	.....	.95	.8	1.15	1.05	28	1.1	85	1.0	1.10	1.05
14	.....	.9	.85	1.15	1.05	29	1.1	.85	.95	1.10	1.05
15	1.35	.85	.85	1.10	1.05	30	1.05	.85	.95	1.10	1.05
						31	1.0	.85	.....	1.10	.....

TENMILE CREEK NEAR HELENA, MONT.

This station, which is located opposite the Broadwater Hotel, near Helena, Mont., was established July 8, 1908, to determine the amount of water available for irrigation and for municipal supply.

Part of the water supply of the city of Helena is taken from Tenmile Creek above the station. Two irrigation ditches also take their water from this creek above the gage. The entire low-water flow is appropriated and used before it reaches the mouth of the creek.

The principal tributaries above the gaging station are Blue Cloud, Spring, and Walker creeks; Sevenmile Creek enters 2 miles below.

The channel shifts somewhat during flood stages, but at medium and low water the conditions are good for obtaining accurate discharge data. The stream freezes over during the winter months and no records are kept.

Discharge measurements of Tenmile Creek near Helena, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 8	J. E. Stewart	20	26.7	2.19	22.6
July 16	do	20	20.3	1.93	11.6
August 11	Raymond Richards	.....	.....	1.25	*a* .5
October 26	do	34	25.4	2.49	31.8

a Estimated.

Daily gage height, in feet, of Tenmile Creek near Helena, Mont., for 1908.

[Harry Hillman, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.5	1.3	2.0	2.5	16	1.9	1.4	1.4	2.85	2.55
2	.....	1.45	1.3	2.2	2.5	17	2.0	1.45	1.65	2.7	2.4
3	.....	1.4	1.25	2.55	2.5	18	2.0	1.45	1.95	2.6	2.4
4	.....	1.35	1.25	2.15	2.5	19	1.9	1.4	2.0	2.6	2.3
5	.....	1.35	1.25	2.3	2.45	20	1.9	1.9	1.85	2.6	2.3
6	.....	1.3	1.2	2.25	2.45	21	1.85	1.4	1.8	2.6	2.3
7	.....	1.25	1.35	2.3	2.45	22	1.85	1.4	1.75	2.5	2.3
8	2.2	1.25	1.5	2.4	2.45	23	1.9	1.35	1.75	2.5	2.3
9	2.15	1.25	1.6	2.4	2.35	24	1.8	1.35	1.8	2.5	2.2
10	2.1	1.25	1.4	2.45	2.3	25	1.75	1.35	1.8	2.5	2.25
11	2.1	1.25	1.4	2.6	2.25	26	1.75	1.3	1.8	2.5	2.25
12	2.05	1.25	1.3	2.75	2.25	27	1.7	1.3	1.8	2.5	2.2
13	2.05	1.3	1.3	2.8	2.3	28	1.65	1.3	1.85	2.5	2.15
14	2.0	1.65	1.3	2.9	2.5	29	1.6	1.3	1.9	2.5	2.2
15	1.9	1.55	1.3	3.0	2.55	30	1.5	1.3	1.95	2.5	2.0
						31	1.5	1.35	.....	2.5	.....

Rating table for Tenmile Creek near Helena, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	0.	1.60	4.0	2.10	19.0	2.60	59
1.20	.5	1.70	6.0	2.20	25	2.70	70
1.30	1.0	1.80	8.5	2.30	32	2.80	82
1.40	1.5	1.90	11.5	2.40	40	2.90	95
1.50	2.5	2.00	15.0	2.50	49	3.00	109

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1908–9 and is well defined.

Monthly discharge of Tenmile Creek near Helena, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 8–31	25	2.5	11.8	562	A.
August	11.5	.8	1.76	108	C.
September	15.0	.5	5.20	309	B.
October	109	15.0	52.8	3,250	A.
November	54	15.0	36.4	2,170	A.

SEVENMILE CREEK NEAR HELENA, MONT.

This station, which is located at Doctor Head's ranch, near Helena, Mont., was established July 16, 1908, and discontinued August 26 of the same year. The records determine the value of the stream for irrigation and municipal water supply.

The entire flow of this creek is appropriated and used for irrigation.

Discharge measurements of Sevenmile Creek near Helena, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 16	J. E. Stewart	9.5	7.2	1.42	12.0
August 11	Raymond Richards	6.0	1.9	.89	2.8

Daily gage height, in feet, of Sevenmile Creek near Helena, Mont., for 1908.

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1		1.10	11		1.10	21	1.40	2.00
2		1.10	12		1.32	22	1.40	2.00
3		1.10	13		1.40	23	1.30	2.00
4		1.10	14		1.40	24	1.32	2.00
5		1.10	15		1.40	25	1.32	2.00
6		1.10	16	1.42	1.40	26	1.30	2.00
7		1.10	17	1.42	1.80	27	1.30	
8		1.10	18	1.42	1.80	28	1.30	
9		1.10	19	1.40	2.00	29	1.35	
10		1.10	20	1.40	2.00	30	1.30	
						31	1.30	

DEARBORN RIVER DRAINAGE BASIN.

DESCRIPTION.

Dearborn River rises on the eastern slope of the Rocky Mountains in Lewis and Clark County, Mont., and takes a general southeasterly course to its junction with the Missouri about 40 miles southwest of Great Falls.

The construction of a project under the Carey Act to reclaim about 30,000 acres of land was undertaken several years ago. The water supply for this project comes from the natural flow of the Dearborn at a point just below the mouth of Falls Creek.

The following gaging stations have been maintained in this drainage basin:

Dearborn River near Clemons, Mont., 1908.
Falls Creek near Clemons, Mont., 1908.

DEARBORN RIVER NEAR CLEMONS, MONT.

This station, which was established May 4, 1908, to obtain information concerning the amount of water available for irrigation, is located 2 miles above Clemons, Mont., and one-half mile above the headworks of the reclamation project.

The only important tributary near the station is Falls Creek, which enters one-half mile below. The drainage area is 110 square miles.

Measurements at this station are made by wading. The conditions are good for obtaining accurate results at low and medium stages, but measurements at flood stages are impossible. The stream freezes over during the winter, and no record of gage heights is kept. The datum of the gage has remained unchanged.

Discharge measurements of Dearborn River near Clemons, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Stewart & Richards	35	48.8	0.60	104
July 13	Raymond Richards	68	72.9	.43	156
August 29	do	59	40.6	— .03	55.6
October 16	do	61	86	.61	217

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Dearborn River near Clemons, Mont., for 1908.

[A. F. Kenck and O. A. Kenck, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				0.17			0.15
2			0.68		—0.20	0.00	
3				.13		— .04	.15
4	0.60		.68		— .22		
5	.65			.10		— .03	.13
6	.80		.55		— .22		
7	.85			.10		.12	.13
8			.50		— .25		
9	.88			.08		.22	.11
10					— .25	.30	
11	1.03		.48	.10			.12
12		1.93	.45		— .27	.57	
13	.98		.43	.18			.12
14		1.40			— .27	.88	
15	1.15		.42	.14			.12
16		1.37			— .20	.61	
17	1.10		.40	.00	— .10		.12
18		1.10			.00	.43	
19	1.12		.23	.02			.11
20		1.00			— .05	.38	
21	1.10		.18	.00			.11
22		.85			— .05	.27	
23	1.01		.20	.00			.11
24	1.10	.82	.20		— .05	.21	
25				— .07			.09
26	1.80	.80	.18		— .05	.20	
27				— .05			.09
28	1.40	.78	.18		— .08	.15	
29				— .02			.05
30	1.60	.70	.18		— .06	.15	.06
31				— .20			

NOTE.—From June 1–11 observer was unable to get to the gage on account of high water.

FALLS CREEK NEAR CLEMONS, MONT.

This station, which is located 1½ miles above Clemons, Mont., and 500 feet above the mouth of the creek, was established May 4, 1908, to obtain data for use in connection with water-power and irrigation development.

Falls Creek has a large fall above the gaging station and affords opportunities for water-power development. No water is diverted from this stream, its entire flow reaching Dearborn River.

The conditions for obtaining accurate discharge measurements are fair at medium and low stages. Measurements are impossible at

flood stages, as they can be made only by wading. No records are kept during the winter, as the gage heights are affected by ice. The datum of the gage has remained unchanged.

Discharge measurements of Falls Creek near Clemons, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Stewart and Richards	25	22.8	1.31	29.7
July 13	Raymond Richards	35	34.4	1.37	79.7
August 29	do	28	18.4	1.01	30.5
October 16	do	32	34.2	1.43	78.7

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Falls Creek near Clemons, Mont., for 1908.

[A. F. Kenck and O. A. Kenck, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				1.18			1.15	16					0.96	1.43	
2					0.97	1.40		17	1.80		1.30	1.15	1.00		1.10
3				1.12		1.10	1.13	18					1.05	1.32	
4	1.31				.95			19	1.85		1.28	1.11			1.09
5	1.32			1.10		1.05	1.13	20					.95	1.30	
6	1.35				.96			21			1.25	1.05			1.10
7	1.42			1.10		1.05	1.13	22					.95	1.24	
8					.95			23			1.24	1.05			1.09
9	1.53			1.10		1.09	1.12	24			1.20		.95	1.20	
10					.95	1.12		25				1.01			1.07
11	1.65			1.11			1.10	26			1.18		.97	1.18	
12					.93	1.25		27				1.00			1.07
13	1.68		1.37	1.19			1.10	28			1.18		.98	1.18	
14					.92	1.40		29				1.00			1.03
15	1.79		1.34	1.17			1.10	30			1.18		.98	1.15	1.03
								31				.98			

NOTE.—Gage washed out by flood May 21, 1908.

SMITH RIVER DRAINAGE BASIN.

SMITH RIVER AT TRULY, MONT.

Smith River rises in the Crazy Mountains in southern Meagher County, Mont., flows northwestward, and enters the Missouri about 15 miles southwest of Great Falls.

Only one gaging station has been maintained in this basin. This station, which was established March 7, 1905, and was discontinued June 30, 1907, was located at a steel highway bridge on the county road running up Smith River valley, near the discontinued post-office of Truly and about 20 miles southwest of Great Falls. The data are valuable in connection with irrigation development in Smith River valley.

Discharge measurements of Smith River at Truly, Mont., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 7	Porter and Bird	87	119	1.80	163
March 11	Stockman and Porter	81	101	1.62	125
Sept. 1	A. P. Porter	.....	40	1.20	31.0
1906.					
April 9	Morse and Edson	99	164	2.37	423
May 21	Gordon Edson	99	152	2.32	397
July 12	Raymond Richards	99	163	2.31	317
November 28[a]	....do	65	50	1.60	79.9
1907.					
April 22	J. E. Stewart	98	154	2.29	329

[a] Made by wading.

Daily gage height, in feet, of Smith River at Truly, Mont., for 1907.

[Henry V. Evans and David H. Evans, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	1.68	2.20	1.75	1.95	2.30	3.95	16	.....	2.75	1.80	2.65	2.65	3.70
2	1.75	.....	1.80	2.50	2.30	4.00	17	.....	2.75	1.75	2.60	2.95	3.50
3	1.60	.....	1.80	2.85	2.25	4.10	18	2.20	2.58	1.80	2.50	3.15	3.35
4	1.48	.....	1.70	3.10	2.20	4.10	19	.....	2.05	2.15	2.40	3.30	3.20
5	1.65	2.30	1.82	3.25	2.20	4.00	20	.....	2.25	2.68	2.40	3.55	3.15
6	.....	3.92	1.85	3.00	2.20	3.95	21	.....	2.75	3.40	2.30	4.50	3.25
7	.....	3.82	1.80	2.95	2.12	4.05	22	2.20	3.60	3.90	2.30	4.45	3.35
8	1.80	4.05	1.80	2.65	2.30	4.00	23	.....	3.45	4.10	2.35	4.65	5.05
9	.....	3.70	1.85	2.55	2.45	4.00	24	.....	2.52	3.95	2.40	4.55	9.00
10	.....	2.90	1.88	2.55	2.55	3.85	25	2.20	2.25	3.05	2.35	4.40	8.65
11	.....	2.70	1.78	2.70	2.65	3.85	26	.....	2.15	2.65	2.30	4.10	6.90
12	.....	2.85	1.75	2.95	2.75	3.85	27	.....	1.95	1.92	2.25	3.80	5.75
13	.....	2.75	1.80	2.75	2.75	3.75	28	.....	1.75	1.82	2.25	3.65	5.35
14	.....	2.75	1.78	2.65	2.65	3.95	29	2.20	.....	1.85	2.20	3.60	5.15
15	2.10	2.95	1.70	2.60	2.60	3.80	30	.....	.....	1.82	2.30	3.60	4.80
							31	.....	.....	1.80	.....	3.75	.....

NOTE.—River frozen Jan. 1–Feb. 14, 1907.

Rating table for Smith River at Truly, Mont., for 1905–1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	10	1.60	111	2.20	321	2.80	609
1.10	20	1.70	140	2.30	365	2.90	660
1.20	32	1.80	173	2.40	412	3.00	712
1.30	47	1.90	207	2.50	460	3.10	765
1.40	65	2.00	242	2.60	509	3.20	819
1.50	86	2.10	280	2.70	559		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made in 1905–1907, and is fairly well defined between gage heights 1.2 feet and 2.5 feet. Above gage height 3.2 feet the rating curve is a tangent, the difference being 55 per tenth.

Monthly discharge of Smith River at Truly, Mont., for 1905–1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
March 7–31	173	76	135	6,690	A.
April	140	86	109	6,490	B.
May	224	86	149	9,160	A.
June	534	200	336	20,000	B.
July	300	86	154	9,470	A.
August	173	40	74.6	4,590	B.
September	44	26	31.7	1,890	C.
October	126	44	67.3	4,140	B.
November	98	40	83.3	4,960	B.
December	140	56	86.5	5,320	C.
The period				72,700	
1906.					
March 24–31	660	163	434	6,890	B.
April	559	242	331	19,700	B.
May	863	207	392	24,100	B.
June	1,250	712	974	58,000	C.
July	702	76	322	19,800	B.
October	117	86	107	6,580	B.
November 1–16	126	111	116	3,680	B.
The period				139,000	
1907.					
February 15–28	1,040	156	502	14,900	B.
March	1,310	140	348	21,400	B.
April	846	224	489	29,100	B.
May	1,620	288	796	48,900	C.
June	4,010	792	1,460	86,900	D.

SUN RIVER DRAINAGE BASIN.

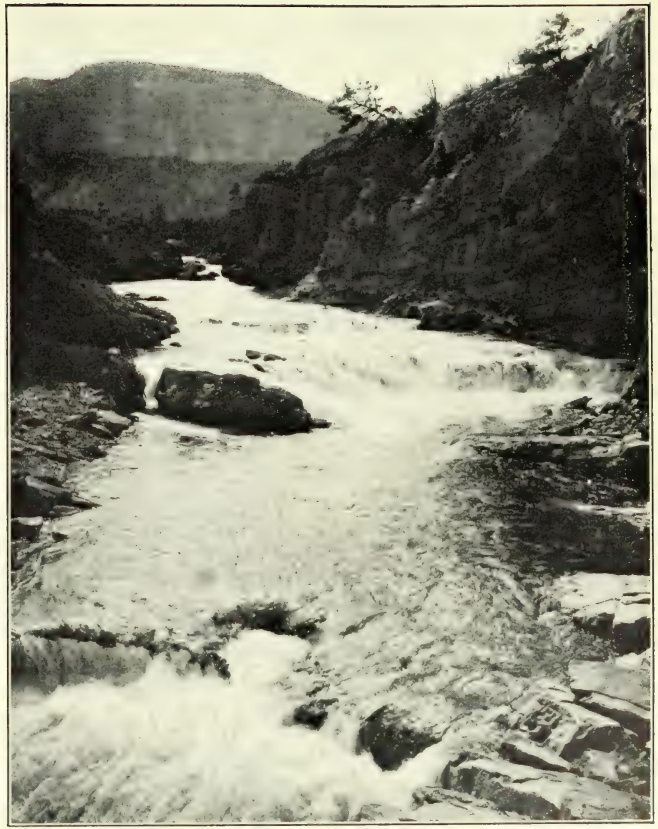
DESCRIPTION.

Sun River rises on the eastern slope of the Rocky Mountains in northwestern Montana, flows southward for about 60 miles, then, turning abruptly, flows eastward through a canyon, emerging on a level plain, through which it runs for 75 miles to its junction with the Missouri at Great Falls. The area of the drainage basin is about 2,240 square miles.

South Fork and Willow Creek, its only important tributaries, rise in the mountains and are perennial streams. The others are small intermittent streams whose drainage areas lie entirely within the plains region.

The valley of Sun River proper is from 1 to 3 miles wide and the river flows from 5 to 25 feet below its general surface. Steeply sloping bluffs, about 300 feet high, border this valley, and between these bluffs and the adjoining river valley are comparatively smooth bench lands. The highest peak in the mountains stands about 8,900 feet above sea level; the altitude of the river at the canyon where it leaves the mountains is 4,450 feet; at its mouth it is 3,300 feet above sea level.

A. SUN RIVER CANYON ABOVE POINT OF DIVERSION, SUN RIVER PROJECT, MONTANA.



B. SUN RIVER CANYON DIVERSION SITE, SUN RIVER PROJECT, MONTANA.

The mountainous part of the basin is included in the Lewis and Clark National Forest, and is heavily timbered. The plains section is treeless except for a few willows and cottonwoods along the streams.

The mean annual rainfall varies from 12 inches in the plains region to about 45 inches in the mountainous sections. The heaviest rainfall occurs during the month of June, but the regular June floods are caused by the melting snow in the mountains. During the greater part of the winter season all the streams are frozen over.

Much of the land in the valley has been irrigated, and the ordinary summer flow of the stream is practically all utilized. The United States Reclamation Service has started construction on an irrigation project that will store the flood water of Sun River and its tributaries and carry it to the higher bench lands at the north of the valley, where 260,000 acres of irrigable land can be reclaimed. (See Pl. IV.) A number of reservoir sites have been selected, the largest being the Warm Springs reservoir with a capacity of 156,800 acre-feet. The other reservoirs are the Willow Creek, with a capacity of 84,320 acre-feet; the Pishkun, with a capacity of 45,747 acre-feet, and the Benton Lake, with a capacity of 140,200 acre-feet.

Natural power opportunities are good, as Sun River has a minimum flow at the point where it leaves the mountains of 150 second-feet and a fall of about 40 feet to the mile.

The following gaging stations have been maintained in this river basin:

North Fork of Sun River near Augusta, Mont., 1889–90, 1903–1908.
Sun River at Sun River, Mont., 1905–1908.
Sun River near Great Falls, Mont., 1897.
South Fork of Sun River at Augusta, Mont., 1904–1908.
Willow Creek near Augusta, Mont., 1905–1908.
Ford Creek near Augusta, Mont., 1906–1908.
Smith Creek near Augusta, Mont., 1906–1908.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

This station, which is situated below the head of the Kilraven ditch, near Christian's ranch, 12 miles northwest of Augusta and 21 miles southwest of Choteau, Mont., was established October 31, 1903, to determine the amount of water available for storage and irrigation.

The only important tributaries are Willow Creek and the South Fork of Sun River, both of which enter several miles below the gaging station. Very little water is diverted above the station, but below nearly all of the valley land is irrigated from this stream.

The gage datum has not been changed since the station was established. Conditions for obtaining accurate discharge data are excellent except during the winter months, when the discharge is affected by ice.

Discharge measurements of North Fork of Sun River near Augusta, Mont., in 1907 and 1908.

Date	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	Follansbee and Stewart	130	388	1.76	749
May 26	J. E. Stewart	138	559	3.06	2,150
June 13	do	144	763	4.40	4,300
August 2	do	152	504	2.36	1,340
September 19	Follansbee and Stewart	116	330	1.19	408
September 20	do	107	160	(a)	389
1908.					
May 28	Raymond Richards	140	599	3.11	2,160
July 11	do	140	586	2.47	1,690
August 30	do	135	312	.77	390
October 15	do	135	402	1.34	721

a Made at mouth of canyon, 10 miles above regular station. Regular gage read 1.19.

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1907 and 1908.

[G. B. Christian, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.a												
1		0.9	1.2	0.6	1.6	4.9	4.5	2.4	1.4		0.9	0.7
2			1.0	.6	1.6	5.6	4.4	2.4	1.4	1.1	.9	.7
3			.9	.6	1.6	5.1	4.6	2.3	1.3	1.1	.9	.8
4			.8	.7	1.6	4.6	4.7	2.3	1.3	1.1	.9	.8
5	1.7		.7	1.0	1.6	4.6	4.5	2.3	1.3	1.1	.9	.7
6			.6	1.0	1.5	5.0	4.1	2.2	1.3	1.1	.9	.7
7			.7	1.0	1.5	5.0	3.9	2.1	1.3	1.1	.9	.8
8		2.5	.7	1.0	1.7	5.2	3.7	2.0	1.3	1.0	.9	.7
9			.7	1.1	2.0	4.6	3.9	2.0	1.3	1.0	.9	.8
10	1.7		.7	1.5	2.4	4.4	3.9	2.0	1.2	1.0	.9	.8
11			.7	1.6	3.2	4.0	3.8	1.9	1.2	1.0	.9	.8
12			.6	1.5	3.1	4.2	3.8	1.9	1.3	1.0	.9	.8
13			.6	1.6	3.1	4.3	3.6	1.8	1.3	1.0	.9	.7
14			.6	1.8	3.1	4.0	3.4	1.7	1.2	1.0	.9	.7
15		2.3	.5	2.0	3.4	3.9	3.2	1.7	1.2	1.0	.9	.7
16			.5	2.4	3.7	3.8	3.1	1.7	1.2	1.0	.9	.6
17	1.6	2.0	.5	1.9	4.4	3.6	3.1	1.6	1.2	1.0	.8	.6
18		2.0	.5	1.9	4.4	3.6	3.0	1.6	1.2	1.0	.8	.7
19		1.9	.5	1.8	4.5	3.9	3.0	1.6	1.2	1.0	.8	.7
20		1.8	.6	1.6	5.0	4.3	3.0	1.6	1.2	1.0	.8	.8
21		1.8	.6	1.6	4.5	4.3	3.2	1.5	1.2	1.0	.8	.8
22		1.8	.6	1.8	4.4	4.6	3.3	1.5	1.2	1.0	.8	.7
23		1.7	.6	1.8	3.8	5.3	3.2	1.5	1.2	1.0	.8	.8
24		1.6	.6	1.7	3.5	5.0	3.0	1.5	1.2	1.0	.8	.8
25	.9	1.6	.6	1.6	3.3	4.4	2.9	1.5	1.2	1.0	.8	.8
26		1.5	.6	1.6	3.0	4.5	2.8	1.5	1.1	1.0	.8	.8
27		1.4	.6	1.6	3.4	5.0	2.7	1.5	1.1	1.0	.8	.8
28		1.3	.6	1.5	3.6	5.4	2.6	1.6	1.1	.9	.7	.8
29			.6	1.5	3.8	5.4	2.7	1.5	1.1	.9	.7	.8
30			.6	1.5	3.8	5.0	2.7	1.5	1.1	.9	.7	.8
31			.6		4.0		2.5	1.5		.9		.8
1908.b												
1			.6	.6	2.4	5.2	3.2	1.0	.7	.8	.7	.8
2			.6	.6	2.7	5.5	3.2	1.0	.7	.8	.7	.8
3	.6		.6	.6	2.8	4.8	3.2	1.0	.7	.8	.7	.8
4			.6	.6	2.8	6.5	3.1	1.0	.7	.8	.7	.8
5			.6	.6	2.8	6.5	3.0	1.0	.7	.8	.7	.8
6			.6	.6	3.1	(c)	2.8	1.0	.7	.7	.7	.8
7		.6	.6	.6	3.6	(c)	2.8	.9	.7	.7	.7	.8
8			.7	.6	3.9	(c)	2.8	.9	.7	.7	.7	.8
9	.6		.7	.7	3.4	6.5	2.7	.9	.7	.7	.7	.8
10			.7	.7	3.5	6.2	2.7	.9	.7	.7	.7	.8

a River frozen entirely across January 1 to February 16, 1907. Recorded gage readings are to water surface.

b River frozen January 1 to about March 10, and December 21–31, 1908.

c Water over top of gage June 6, 7, 8, 1908. From high-water marks the extreme high stage was found to be 9.5 feet. Discharge estimated as 15,000 second-feet.

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
11	.....	.....	0.7	0.8	3.5	6.0	2.7	0.8	0.7	0.7	0.7	0.8
12	.....	.....	.8	1.0	3.4	5.6	2.6	.8	.7	.7	.7	.8
13	.....	.....	.9	1.2	3.2	5.2	2.6	.8	.7	.7	.7	.8
14	.....	0.6	.9	1.5	3.2	4.8	2.5	.8	.7	.7	.7	.8
15	.....	.....	.9	1.3	3.3	4.6	2.5	.8	.7	.7	.7	.8
16	.....	.....	.9	1.2	3.6	4.5	2.4	.8	.8	.7	.7	.8
17	0.6	.....	.9	1.7	3.4	4.4	2.3	.8	.9	.7	.7	.8
18	.....	.....	.9	2.0	3.1	4.1	2.2	.8	.9	.7	.7	.8
19	.....	.....	.8	2.3	3.1	3.9	1.9	.8	.9	.7	.7	.8
20	.....	.....	.8	2.6	3.0	3.6	1.8	.7	.9	.7	.7	.8
21	.....	.6	.8	2.9	2.9	3.4	1.8	.7	.9	.7	.7	.....
22	.....	.....	.7	2.9	2.9	3.2	1.7	.7	.8	.7	.7	.....
23	.....	.....	.7	2.9	2.8	3.2	1.6	.7	.8	.7	.8	.....
24	.6	.....	.7	3.0	2.9	3.2	1.5	.7	.8	.7	.8	.....
25	.....	.....	.7	2.9	3.2	3.6	1.5	.7	.8	.7	.8	.....
26	.....	.....	.7	2.8	3.2	4.0	1.4	.7	.8	.7	.8	.9
27	.....	.....	.7	2.6	3.1	3.7	1.3	.7	.8	.7	.8	.....
28	.....	.6	.7	2.5	3.1	3.2	1.2	.7	.8	.7	.8	.....
29	.....	.....	.7	2.2	3.1	3.0	1.2	.7	.8	.7	.8	.....
30	.....	.....	.7	2.0	3.2	3.0	1.1	.7	.8	.7	.8	.....
31	.9	.....	.7	.....	3.8	.....	1.0	.7	.....	.7	.....	1.1

[a] River frozen January 1 to about March 10, and December 21–31, 1908.

Rating tables for North Fork of Sun River near Augusta, Mont.

JANUARY 1, 1907, TO JUNE 7, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	150	1.80	795	3.10	2,220	4.80	4,980
.60	180	1.90	875	3.20	2,360	5.00	5,360
.70	210	2.00	960	3.30	2,500	5.20	5,740
.80	245	2.10	1,050	3.40	2,650	5.40	6,130
.90	285	2.20	1,145	3.50	2,800	5.60	6,530
1.00	325	2.30	1,255	3.60	2,950	5.80	6,930
1.10	370	2.40	1,360	3.70	3,100	6.00	7,330
1.20	420	2.50	1,470	3.80	3,260	6.20	7,750
1.30	470	2.60	1,580	3.90	3,420	6.40	8,170
1.40	525	2.70	1,700	4.00	3,580	6.60	8,590
1.50	585	2.80	1,820	4.20	3,920		
1.60	650	2.90	1,950	4.40	4,260		
1.70	720	3.00	2,080	4.60	4,620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907–8 and the form of previous curves and is well defined below gage height 5 feet.

JUNE 8, TO DECEMBER, 1908.

0.50	289	1.80	1,040	3.10	2,570	4.80	5,440
.60	325	1.90	1,120	3.20	2,720	5.00	5,820
.70	365	2.00	1,210	3.30	2,870	5.20	6,200
.80	409	2.10	1,300	3.40	3,030	5.40	6,580
.90	457	2.20	1,400	3.50	3,190	5.60	6,960
1.00	509	2.30	1,510	3.60	3,350	5.80	7,360
1.10	565	2.40	1,620	3.70	3,510	6.00	7,760
1.20	624	2.50	1,740	3.80	3,680	6.20	8,160
1.30	686	2.60	1,870	3.90	3,850	6.40	8,560
1.40	751	2.70	2,000	4.00	4,020	6.60	8,960
1.50	820	2.80	2,140	4.20	4,360		
1.60	890	2.90	2,280	4.40	4,720		
1.70	960	3.00	2,420	4.60	5,080		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made after the high water of 1908 and the general form of previous curves and is well defined below gage height 3.0 feet.

Monthly discharge of North Fork of Sun River near Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January			[a] 230	14,100	D.
February			421	23,400	C.
March	420	150	199	12,200	B.
April	1,360	180	596	35,500	A.
May	5,360	585	2,440	150,000	A.
June	6,530	2,950	4,630	276,000	A.
July	4,800	1,470	2,780	171,000	A.
August	1,360	585	818	50,300	A.
September	525	370	434	25,800	A.
October	370	285	330	20,300	B.
November	285	210	263	15,600	C.
December	245	180	228	14,000	D.
The year	6,530		1,110	808,000	
1908.					
March 11–31	285	210	238	9,910	D.
April	2,080	180	856	50,900	A.
May	3,420	1,360	2,320	143,000	A.
June	[a] 15,000	2,420	5,710	340,000	B.
July	2,720	509	1,540	94,700	A.
August	509	365	418	25,700	A.
September	457	365	395	23,500	B.
October	409	365	372	22,900	B.
November	409	365	377	22,400	C.
December 1–20	409	409	409	16,200	D.
The period				739,000	

[a] Estimated.

SUN RIVER AT SUN RIVER, MONT.

This station, which is located at the highway bridge over Sun River, Mont., was established July 31, 1905, to obtain data for use in connection with irrigation projects. The records at this station do not show the total run-off from the drainage area above it, as practically the entire valley above is irrigated from this stream. The greater part of the ordinary summer flow is utilized for irrigation.

The gage datum has not been changed since the station was established. The discharge is affected at times during the winter by ice. The gaging section at the bridge has been very poor since the high water of 1907, but good low-water measurements can be made by wading.

Discharge measurements of Sun River at Sun River, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	Follansbee and Stewart	134	362	3.97	1,100
May 23	J. E. Stewart	257	1,020	6.58	3,700
June 11	do	253	983	6.58	3,790
June 14	do	253	1,020	6.73	3,660
July 17	do	189	1,020	5.59	2,500
July 31	do	149	767	4.71	1,460
September 3	do	92	448	3.02	374
September 21	Follansbee and Stewart	92	405	2.82	348
November 6	J. E. Stewart	148	152	2.60	357
1908.					
May 26	Raymond Richards	208	838	5.80	2,690
June 15	J. E. Stewart	225	1,620	8.00	6,180
June 20	do	224	1,410	7.00	4,510
July 15	Raymond Richards	181	979	5.25	1,640
August 27	do	98	681	3.18	516
October 19	do	97	727	3.50	540

Daily gage height, in feet, of Sun River at Sun River, Mont., for 1907 and 1908.

[R. A. Lange, observer.]

Day.[a]	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	5.20	3.60	2.70	3.60	3.40	7.00	8.20	4.60	3.30	2.75	2.30	2.55
2	5.20	3.65	2.75	3.60	3.40	8.40	7.90	4.20	3.00	2.75	2.35	2.55
3	5.20	3.65	2.75	3.60	3.50	8.20	7.60	4.30	3.00	2.75	2.50	2.55
4	5.20	3.65	2.75	3.80	3.90	7.60	7.60	4.25	3.00	2.75	2.50	2.55
5	5.20	3.65	2.75	3.75	3.90	7.70	7.40	4.00	3.00	2.70	2.50	2.55
6	4.50	3.65	2.60	3.70	3.90	7.90	7.60	4.00	3.00	2.65	2.50	2.55
7	4.50	3.75	2.60	3.65	3.90	7.90	6.90	4.00	3.00	2.65	2.50	2.55
8	4.10	7.95	2.65	3.60	4.90	8.40	6.60	4.10	3.00	2.60	2.50	2.80
9	4.10	7.95	2.65	3.60	4.95	8.00	6.60	4.00	3.00	2.60	2.55	2.80
10	4.00	7.00	2.65	3.70	5.00	7.00	7.00	4.00	3.00	2.60	2.55	2.90
11	3.50	6.50	2.60	3.65	6.00	6.60	6.90	3.90	2.95	2.60	2.55	2.90
12	3.50	5.95	2.70	3.70	6.00	7.00	6.60	3.90	2.95	2.60	2.55	2.85
13	3.50	4.60	2.70	3.80	6.00	7.00	6.60	3.80	2.95	2.60	2.55	2.85
14	3.50	4.50	2.70	4.00	6.50	6.90	6.20	3.85	2.95	2.60	2.50	2.80
15	3.50	4.50	2.65	4.00	5.95	6.60	6.00	3.70	2.95	2.50	2.50	2.80
16	3.20	4.50	2.70	4.00	6.50	6.40	5.90	3.50	2.95	2.50	2.50	2.80
17	3.50	4.50	2.68	4.00	6.65	6.00	5.70	3.50	2.95	2.50	2.55	2.80
18	3.60	3.50	2.68	4.00	7.00	6.00	5.70	3.50	2.95	2.50	2.55	2.80
19	3.60	3.50	2.68	3.90	7.40	6.00	5.60	3.40	2.95	2.50	2.50	2.70
20	3.60	3.00	2.70	3.40	8.00	6.60	5.40	3.40	2.90	2.50	2.50	2.70
21	3.65	3.00	2.70	3.40	7.60	6.90	5.60	3.40	2.80	2.45	2.50	2.75
22	3.50	3.00	2.95	3.60	7.00	7.00	5.60	3.00	2.80	2.45	2.50	2.80
23	3.60	3.00	2.95	3.90	6.60	7.40	5.60	3.00	2.80	2.45	2.50	2.80
24	3.60	2.65	2.95	3.90	6.10	9.60	5.50	3.00	2.80	2.45	2.50	2.80
25	3.60	2.60	2.95	3.70	6.00	9.40	5.40	3.00	2.80	2.40	2.52	2.80
26	3.60	2.60	2.95	3.90	5.80	8.60	5.40	3.00	2.80	2.40	2.52	2.80
27	3.60	2.60	2.95	3.90	5.50	8.00	5.40	3.00	2.80	2.40	2.55	2.80
28	3.60	2.65	2.95	3.90	5.50	8.60	4.80	3.20	2.80	2.40	2.55	2.80
29	3.70	.....	2.90	3.40	5.50	8.60	4.80	4.00	2.80	2.40	2.55	2.80
30	3.50	.....	2.85	3.40	6.40	8.60	4.50	3.90	2.78	2.40	2.55	2.75
31	3.55	.....	2.85	.....	6.90	.....	4.70	3.60	.....	2.30	.....	2.75
1908.[b]												
1	2.75	5.0	2.0	2.0	3.8	8.5	6.0	3.95	3.15	3.6	3.5	3.0
2	2.80	4.2	2.0	2.0	4.0	9.8	6.0	3.8	3.1	3.6	3.45	3.0
3	2.78	4.2	2.0	2.0	4.5	8.75	6.0	3.8	3.0	3.65	3.4	3.0
4	2.50	4.2	1.95	2.0	5.0	9.8	6.0	3.65	3.0	3.55	3.4	3.0
5	2.80	4.2	1.95	2.0	4.8	12.0	6.0	3.5	3.0	3.5	3.3	3.0
6	2.78	4.2	2.0	2.0	5.2	12.5	6.0	3.5	3.0	3.5	3.3	3.2
7	2.75	4.2	2.0	2.0	5.9	[c]12.0	5.95	3.5	3.0	3.5	3.3	3.1
8	2.75	4.2	2.0	2.0	6.4	13.0	5.95	3.4	3.0	3.5	3.3	3.1
9	2.75	4.5	2.0	2.0	6.0	11.5	5.5	3.2	3.0	3.4	3.2	3.1
10	2.75	4.5	2.0	2.0	6.0	9.5	5.4	3.0	3.0	3.4	3.2	3.2
11	2.75	4.5	2.0	2.0	6.0	9.3	5.3	3.0	2.95	3.4	3.2	3.2
12	3.00	4.5	2.0	2.5	5.9	8.5	5.3	2.95	2.95	3.15	3.15	3.2
13	3.00	4.4	2.0	2.8	5.6	8.0	5.0	2.9	2.95	3.15	3.1	3.0
14	2.9	4.35	2.0	3.2	5.95	8.0	5.2	3.0	2.95	3.15	3.1	3.0
15	2.9	4.3	2.0	3.1	5.95	8.0	5.15	3.0	2.95	3.15	3.5	3.0
16	2.85	.....	2.0	3.8	6.0	8.0	5.1	3.0	3.2	3.65	3.5	3.0
17	2.7	4.0	2.0	3.6	6.0	8.0	5.0	3.5	3.2	3.6	3.5	3.0
18	2.8	4.0	2.1	3.6	5.4	7.5	5.0	3.0	3.5	3.5	3.5	3.0
19	2.8	3.95	2.1	4.0	5.45	7.1	4.95	2.85	3.5	3.5	3.5	3.0
20	2.9	3.9	2.1	4.5	5.35	7.0	4.7	2.85	3.45	3.5	3.5	3.0
21	2.9	3.9	2.0	5.0	5.35	7.0	4.5	2.85	3.45	3.65	3.5	3.0
22	3.0	3.9	2.0	5.0	5.25	6.9	4.35	2.8	3.45	3.65	3.4	2.85
23	3.0	3.5	2.0	5.9	5.2	6.6	4.35	2.75	3.45	3.65	3.3	2.85
24	2.95	3.0	2.0	5.4	5.2	6.5	4.35	2.7	3.45	3.65	3.3	2.8
25	3.0	3.0	2.0	5.0	5.2	6.4	4.2	4.0	3.5	3.6	3.25	2.8
26	2.9	2.9	2.0	4.8	5.0	7.0	4.0	3.7	3.5	3.6	3.0	2.8
27	3.5	2.5	2.0	4.6	5.2	6.8	4.0	2.85	3.5	3.6	3.0	2.75
28	3.6	2.5	2.0	4.0	5.9	6.5	4.0	3.15	3.55	3.5	3.0	2.75
29	3.7	2.5	2.0	3.1	6.0	6.3	4.0	3.15	3.6	3.5	3.0	2.7
30	4.8	.....	2.0	3.1	5.95	6.0	3.95	3.15	3.6	3.4	3.0	2.7
31	5.0	.....	2.0	.....	7.0	.....	3.95	3.15	.....	3.4	.....	2.7

[a] Ice conditions for about January 10, February 12, and part of December, 1907.
[b] Ice conditions during February, 1908.
[c] The maximum flood gage height on June 7, 1908, was 13.4 feet.

Rating tables for Sun River at Sun River, Mont.

JANUARY 1 TO JUNE 8, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	410	3.80	985	5.00	1,960	6.40	3,560
2.70	440	3.90	1,050	5.10	2,060	6.60	3,820
2.80	475	4.00	1,120	5.20	2,160	6.80	4,090
2.90	510	4.10	1,190	5.30	2,260	7.00	4,370
3.00	550	4.20	1,260	5.40	2,370	7.20	4,660
3.10	595	4.30	1,340	5.50	2,480	7.40	4,960
3.20	640	4.40	1,420	5.60	2,590	7.60	5,270
3.30	690	4.50	1,500	5.70	2,700	7.80	5,590
3.40	745	4.60	1,590	5.80	2,820	8.00	5,920
3.50	800	4.70	1,680	5.90	2,940	8.20	6,260
3.60	860	4.80	1,770	6.00	3,060	8.40	6,600
3.70	920	4.90	1,860	6.20	3,300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the curve after high water. It is not well defined.

JUNE 9 TO SEPTEMBER 20, 1907.

2.30	186	3.70	729	5.10	1,890	7.00	4,270
2.40	210	3.80	788	5.20	2,000	7.20	4,570
2.50	235	3.90	850	5.30	2,110	7.40	4,880
2.60	262	4.00	915	5.40	2,220	7.60	5,200
2.70	292	4.10	985	5.50	2,330	7.80	5,520
2.80	323	4.20	1,060	5.60	2,440	8.00	5,860
2.90	358	4.30	1,140	5.70	2,560	8.20	6,200
3.00	395	4.40	1,220	5.80	2,680	8.40	6,550
3.10	435	4.50	1,310	5.90	2,800	8.60	6,910
3.20	478	4.60	1,400	6.00	2,920	8.80	7,280
3.30	523	4.70	1,490	6.20	3,170	9.00	7,660
3.40	570	4.80	1,590	6.40	3,430	9.20	8,050
3.50	620	4.90	1,690	6.60	3,700		
3.60	673	5.00	1,790	6.80	3,980		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during the above period and is well defined below gage height 7.0 feet. Above gage height 9.2 feet the curve is a tangent, the difference being 200 per tenth.

SEPTEMBER 21 TO DECEMBER 31, 1907.

[The indirect method applied, the previous curve being used as standard.]

JANUARY 1 TO AUGUST 8, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	78	3.30	523	4.70	1,490	7.20	4,710
2.00	100	3.40	570	4.80	1,590	7.40	5,040
2.10	124	3.50	620	4.90	1,690	7.60	5,380
2.20	149	3.60	673	5.00	1,790	7.80	5,740
2.30	175	3.70	729	5.20	2,000	8.00	6,110
2.40	202	3.80	788	5.40	2,220	8.20	6,490
2.50	231	3.90	850	5.60	2,440	8.40	6,870
2.60	261	4.00	915	5.80	2,680	8.60	7,270
2.70	292	4.10	985	6.00	2,930	8.80	7,670
2.80	323	4.20	1,060	6.20	3,200	9.00	8,070
2.90	358	4.30	1,140	6.40	3,480	10.00	10,220
3.00	395	4.40	1,220	6.60	3,780	11.00	12,500
3.10	435	4.50	1,310	6.80	4,080	12.00	14,900
3.20	478	4.60	1,400	7.00	4,390	13.00	17,400

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907–8 and is well defined below gage height 9.0 feet. Above 9.0 feet the curve is somewhat uncertain.

AUGUST 9 TO DECEMBER 31, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Sun River at Sun River, Mont., for 1907 and 1908.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1907.					1907.				
1		350	255	350	16		280	328	430
2		355	270	350	17		290	345	430
3		355	320	350	18		290	345	430
4		355	320	350	19		290	330	395
5		335	320	350	20		290	330	395
6		315	320	350	21	340	280	330	410
7		325	320	350	22	340	285	330	430
8		310	320	430	23	340	285	330	430
9		310	340	430	24	340	285	330	430
10		310	340	475	25	340	268	340	430
11		310	340	475	26	340	268	340	430
12		315	340	455	27	360	280	350	430
13		315	340	455	28	360	280	350	430
14		315	328	430	29	360	280	350	430
15		280	328	430	30	355	280	350	410
					31		245		410

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.						1908.					
1		480	620	560	350	16	415	478	615	560	350
2		455	620	535	350	17	645	478	590	560	350
3		415	645	515	350	18	435	620	540	560	350
4		415	595	515	350	19	375	620	540	560	350
5		415	570	470	350	20	375	595	540	560	350
6		415	570	470	425	21	375	565	620	560	350
7		415	570	470	390	22	360	565	620	515	300
8		415	570	470	390	23	340	565	620	470	300
9	500	415	520	425	390	24	325	565	620	470	290
10	415	415	520	425	425	25	965	590	605	450	290
11	415	375	520	425	425	26	782	590	605	350	290
12	390	375	400	405	425	27	375	590	605	350	285
13	370	375	400	390	350	28	480	620	560	350	285
14	415	375	400	390	350	29	480	645	560	350	280
15	415	375	400	560	350	30	480	645	515	350	280
						31	480		515		280

Monthly discharge of Sun River at Sun River, Mont., for 1907 and 1908.

Month.	Discharge in second-feet			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January			[a] 400	24,600	D.
February			[a] 750	41,700	D.
March	530	410	463	28,500	C.
April	1,120	745	947	56,400	B.
May	5,920	745	2,860	176,000	B.
June	8,850	2,920	5,210	310,000	B.
July	6,200	1,310	3,250	200,000	B.
August	1,400	395	747	45,900	B.
September	523	340	376	22,400	B.
October	355	245	301	18,500	B.
November	350	255	329	19,600	C.
December	475	350	412	25,300	D.
The year	8,850		1,340	969,000	

[a] Estimated.

Monthly discharge of Sun River at Sun River, Mont., for 1907 and 1908—Continued.

Month.	Discharged in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	1,790	231	457	28,100	D.
March	124	89	102	6,270	C.
April	2,800	100	736	43,800	B.
May	4,390	788	2,380	146,000	A.
June	17,400	2,930	7,290	434,000	B.
July	2,930	882	1,870	115,000	B.
August	965	325	522	32,100	B.
September	645	375	495	29,500	B.
October	645	400	555	34,100	B.
November	560	350	468	27,800	C.
December	425	280	344	21,200	D.
The period				918,000	

SOUTH FORK OF SUN RIVER AT AUGUSTA, MONT.

This station, which is located at the highway bridge on the road from Augusta to Craig, Mont., about one-half mile from Augusta, was established December 2, 1904, to obtain run-off data for use in connection with the Sun River Irrigation project.

Water is diverted to irrigate the valley lands, both above and below the stations. During dry seasons the entire summer flow is utilized.

The original gage was spiked to the crib work of the right abutment on the downstream side of the bridge. On April 17, 1907, a new gage was established 100 yards above the bridge. This gage is spiked to a tree on the left bank and is set at a different datum. The gage heights are affected by ice during the winter.

Discharge measurements of South Fork of Sun River at Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.[a]		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	Follansbee and Stewart	32	49.4	[b] 2.05	106
May 24	J. E. Stewart	35	91	2.96	399
June 12	do	34	67	2.60	247
June 26	do	85	296	4.11	1,120
August 1	do	34	54	2.11	124
September 18	Follansbee and Stewart	32	36.9	1.80	45.7
1908.					
May 4	Stewart and Richards	26	17.7	1.48	10.8
May 27	Raymond Richards	69	192	3.36	652
June 18	J. E. Stewart	70	178	3.70	[d] 475
July 11	Raymond Richards	52	42.1	2.92	[c] 105
August 28	do	21	21	2.45	[c] 51.1
October 17	do	30	28.6	2.83	81.6

[a] Measurements were made at different sections.
[b] Old gage read 1.27.
[c] Made by wading.
[d] Old gage on bridge read 1.96.

Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., for 1907 and 1908.

[Richard Auchard, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	1.0	1.1	2.1	3.2	2.95	2.1	1.8	1.8	1.7	1.7
2	.....	1.0	1.1	2.1	3.25	2.8	2.1	1.8	1.8	1.7	1.7
3	.....	1.0	1.2	2.1	3.25	2.7	2.0	1.8	1.8	1.7	1.7
4	.....	1.0	1.2	2.1	3.2	2.7	2.0	1.8	1.8	1.7	1.7
5	.....	1.0	1.2	2.2	3.1	2.6	2.0	1.8	1.8	1.7	1.7
6	.....	1.0	1.2	2.2	3.0	2.55	2.0	1.8	1.75	1.7	1.7
7	.....	1.0	1.2	2.2	2.9	2.5	2.0	1.8	1.75	1.7	1.7
8	2.25	1.0	1.2	2.3	2.9	2.5	2.0	1.8	1.75	1.7	1.7
9	3.1	1.0	1.2	2.3	2.8	2.5	2.0	1.75	1.75	1.7	1.7
10	2.5	1.0	1.2	2.3	2.7	2.6	2.0	1.75	1.75	1.7	1.7
11	2.3	1.0	1.2	2.5	2.6	2.5	2.0	1.75	1.75	1.7	1.7
12	2.0	1.0	1.2	2.5	2.6	2.5	1.9	1.75	1.75	1.7	1.7
13	1.5	.9	1.2	2.5	2.6	2.4	1.9	1.8	1.75	1.7	1.7
14	1.3	.9	1.2	2.5	2.5	2.4	1.9	1.8	1.75	1.7	1.7
15	1.3	.9	1.3	2.5	2.5	2.35	1.9	1.8	1.75	1.7	1.7
16	1.3	1.0	1.25	2.5	2.5	2.35	1.9	1.8	1.75	1.7	.....
17	1.2	1.0	1.25	2.8	2.4	2.3	1.9	1.8	1.75	1.7	.....
18	1.1	1.1	1.3	2.85	2.35	2.3	1.9	1.8	1.75	1.7	.....
19	1.1	1.1	1.3	3.1	2.3	2.3	1.9	1.8	1.75	1.7	.....
20	1.1	1.1	2.0	3.1	2.25	2.4	1.9	1.8	1.75	1.7	.....
21	1.1	1.1	2.0	3.1	3.45	2.4	1.9	1.75	1.75	1.7	.....
22	1.1	1.1	2.0	3.1	3.55	2.4	1.9	1.75	1.7	1.7	.....
23	1.1	1.1	2.0	3.1	4.85	2.35	1.9	1.75	1.7	1.7	.....
24	1.1	1.1	2.0	3.0	4.9	2.3	1.9	1.75	1.7	1.7	.....
25	1.1	1.1	2.05	2.85	4.3	2.2	1.9	1.75	1.7	1.7	.....
26	1.1	1.1	2.05	2.8	4.1	2.2	1.9	1.75	1.7	1.7	.....
27	1.0	1.1	2.0	2.75	.....	2.2	1.9	1.75	1.7	1.7	.....
28	1.0	1.1	2.0	2.9	3.4	2.1	1.8	1.75	1.7	1.7	.....
29	.....	1.1	2.0	2.95	3.2	2.1	1.8	1.8	1.7	1.7	.....
30	.....	1.1	2.0	3.1	3.15	2.1	1.8	1.8	1.7	1.7	.....
31	.....	1.1	.....	3.2	.....	2.1	1.8	.....	1.7	.....	.....
1908.											
1	.....	.....	1.70	1.50	5.45	3.3	2.5	2.4	2.5	2.75	.....
2	.....	.....	1.70	1.50	6.8	3.3	2.5	2.4	2.55	2.75	.....
3	.....	.....	1.70	1.50	5.8	3.12	2.5	2.4	2.55	2.7	.....
4	.....	.....	1.70	1.45	5.3	3.2	2.45	2.35	2.6	2.7	.....
5	.....	.....	1.70	1.45	5.4	3.2	2.45	2.35	2.6	2.65	.....
6	.....	.....	1.70	1.40	6.0	3.15	2.4	2.35	2.65	2.65	.....
7	.....	.....	1.70	1.30	5.85	3.1	2.4	2.3	2.65	2.6	.....
8	.....	.....	1.70	1.40	5.75	3.05	2.4	2.3	2.65	2.6	.....
9	.....	.....	1.70	1.50	5.70	3.0	2.35	2.25	2.6	2.6	.....
10	.....	.....	1.70	1.90	4.92	3.0	2.35	2.25	2.6	2.6	.....
11	.....	.....	1.70	1.90	4.80	3.0	2.35	2.25	2.6	2.4	.....
12	.....	.....	1.70	2.00	4.60	2.95	2.35	2.25	2.6	2.2	.....
13	.....	.....	1.70	2.10	4.40	2.95	2.5	2.25	2.65	2.7	.....
14	.....	1.8	1.70	2.10	4.40	2.9	2.8	2.25	2.7	2.7	.....
15	.....	1.8	1.70	2.20	3.90	2.9	2.5	2.25	2.75	2.9	.....
16	.....	1.8	1.70	2.30	3.80	2.9	2.5	2.3	2.8	2.8	.....
17	.....	1.7	1.70	2.30	3.75	2.9	2.5	2.4	2.8	2.6	.....
18	.....	1.7	1.70	2.30	3.65	2.85	2.5	2.6	2.9	2.7	.....
19	.....	1.7	1.70	2.30	3.65	2.85	2.5	2.5	2.9	2.6	.....
20	.....	1.7	1.70	2.30	3.70	2.7	2.5	2.4	2.9	2.6	.....
21	.....	1.7	1.70	2.40	3.70	2.7	2.5	2.4	2.9	2.7	.....
22	.....	1.7	1.60	2.50	3.65	2.7	2.5	2.4	2.85	2.7	.....
23	.....	1.7	1.60	2.50	3.65	2.7	2.5	2.4	2.85	2.7	.....
24	.....	1.7	1.60	2.50	3.60	2.7	2.5	2.4	2.85	.....	.....
25	.....	1.7	1.60	2.50	3.50	2.65	2.5	2.45	2.85	.....	.....
26	.....	1.7	1.60	2.60	3.40	2.65	2.5	2.45	2.85	.....	.....
27	.....	1.7	1.60	3.20	3.40	2.6	2.5	2.45	2.8	.....	.....
28	.....	1.8	1.55	3.10	3.40	2.6	2.45	2.45	2.8	.....	.....
29	.....	1.8	1.55	3.00	3.40	2.55	2.45	2.45	2.8	.....	.....
30	.....	1.8	1.55	3.10	3.35	2.5	2.45	2.45	2.8	.....	.....
31	.....	1.8	.....	3.60	.....	2.5	2.45	.....	2.8	.....	.....

NOTE.—Beginning April 20, 1907, the gage heights refer to a new gage with a different datum.
Ice conditions January 1 to February 12 (about) and December 16–31, 1907; January 1 to March 31 and November 13 to December 31, 1908.

Rating tables for South Fork of Sun River at Augusta, Mont.

JANUARY 1 TO APRIL 19, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	46	1.10	75	1.30	113	1.50	159
1.00	59	1.20	93	1.40	135		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1907, which cover the range of stage for this period. It is only approximate.

APRIL 20, 1907, TO JUNE 9, 1908.

1.30	2	2.50	232	3.70	834	4.90	1,810
1.40	6	2.60	266	3.80	904	5.00	1,905
1.50	12	2.70	302	3.90	976	5.20	2,110
1.60	21	2.80	340	4.00	1,050	5.40	2,340
1.70	33	2.90	381	4.10	1,126	5.60	2,590
1.80	48	3.00	425	4.20	1,204	5.80	2,850
1.90	66	3.10	472	4.30	1,284	6.00	3,130
2.00	87	3.20	523	4.40	1,366	6.20	3,410
2.10	111	3.30	578	4.50	1,450	6.40	3,700
2.20	138	3.40	637	4.60	1,536	6.60	4,000
2.30	168	3.50	700	4.70	1,624	6.80	4,300
2.40	200	3.60	766	4.80	1,715		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the above period and is fairly well defined below gage height 4.3 feet.

JUNE 10 TO DECEMBER 31, 1908.

2.20	30	2.90	99	3.60	381	4.30	962
2.30	36	3.00	120	3.70	450	4.40	1,062
2.40	43	3.10	145	3.80	526	4.50	1,167
2.50	51	3.20	178	3.90	609	4.60	1,272
2.60	60	3.30	217	4.00	692	4.70	1,382
2.70	70	3.40	264	4.10	777	4.80	1,492
2.80	83	3.50	319	4.20	867	4.90	1,607

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on four discharge measurements made during the above period and the general shape of the previous high-water curve. It is not well defined.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet)	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	.....	.....	20.0	1,230	D.
February	.....	.....	97.3	5,400	D.
March	75	46	65.0	4,000	C.
April	113	75	93.1	5,540	C.
May	523	111	292	18,000	A.
June	1,810	153	552	32,800	A.
July	403	111	205	12,600	A.
August	111	48	72.7	4,470	B.
September	48	40	44.8	2,670	B.
October	48	33	39.0	2,400	B.
November	33	33	33.0	1,960	C.
December	33	.....	26.3	1,620	D.
The year	1,810	.....	.....	92,700	

Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
April	33	16	28.9	1,720	C.
May	766	2	172	10,600	B.
June	4,300	240	1,280	76,200	B.
July	217	51	107	6,580	B.
August	83	40	49.1	3,020	C.
September	60	33	41.3	2,460	C.
October	99	51	76.2	4,690	B.
November (1–12)	76	30	61.2	1,460	B.
The period				107,000	

NOTE.—Discharge estimated for ice periods in 1907.

WILLOW CREEK NEAR AUGUSTA, MONT.

Willow Creek rises on the eastern slopes of the Rocky Mountains in the northwestern part of Lewis and Clark County, Mont., and flows in a general northeasterly direction to its junction with Sun River.

The gaging station, which is located at Jordan's ranch just below the mouth of Little Willow Creek, about 7 miles northwest of Augusta, Mont., was established June 8, 1905, to obtain run-off data for use in connection with the Sun River irrigation project. Willow Creek dam, work on which has been begun, will provide a reservoir with a capacity of 84,320 acre-feet.

Much of the valley land above the station is irrigated, the water being taken from this stream.

Conditions for obtaining accurate discharge data are excellent. No ice forms at this station, as a large spring enters the creek just above the gage. The datum of the gage has not been changed.

Discharge measurements of Willow Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	Follansbee and Stewart	13	16.0	1.32	27.6
May 25	J. E. Stewart	16	38.4	2.73	90.0
June 13	do	16	39.0	2.56	76.0
June 27	do	26	49.0	4.42	176
August 2	do	14	20.4	1.62	37.9
September 19	Follansbee and Stewart	14	11.8	.95	14.1
1908.					
May 5	Stewart and Richards	12	8.4	.75	8.6
May 28	Raymond Richards	25	40.0	3.10	107
June 19	J. E. Stewart	26	45.6	3.94	166
July 11	Raymond Richards	15	23.8	1.78	40.8
August 30	do	14	13.1	1.00	14.9
October 15	do	17	10.0	.92	12.8

NOTE.—Measurements on May 28 and June 19, 1908, made from wagon bridge. All others made by wading at various sections.

Daily gage height, in feet, of Willow Creek near Augusta, Mont., for 1907 and 1908.

[S. N. Jordan, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.68	0.65	1.20	1.30	1.60	3.05	3.70	1.60	1.10	0.95	0.80	0.82
2	.68	.65	1.02	1.25	1.50	3.25	3.50	1.60	1.10	.95	.80	.82
3	.70	.62	1.18	1.45	1.60	3.15	3.40	1.55	1.05	.92	.78	.90
4	.70	.62	1.18	1.35	1.58	3.05	3.25	1.50	1.05	.90	.78	.95
5	.70	.65	1.30	1.35	1.58	2.90	3.10	1.48	1.05	.90	.78	.90
6	.70	.65	1.22	1.30	1.55	2.95	2.95	1.42	1.05	1.02	.78	.90
7	.70	.68	1.35	1.30	1.58	3.15	2.75	1.42	1.05	1.00	.78	.90
8	.68	6.08	1.18	1.28	1.60	3.00	2.70	1.42	1.08	.90	.78	.85
9	.68	4.45	1.20	1.35	1.75	2.90	2.72	1.40	1.05	.85	.78	.85
10	.68	3.32	1.42	1.38	1.75	2.80	2.80	1.40	1.05	.85	.80	.88
11	.65	3.28	1.18	1.45	2.10	2.70	2.65	1.40	1.05	.85	.80	.88
12	.60	2.00	1.18	1.40	2.00	2.65	2.50	1.30	1.10	.85	.80	.88
13	.60	1.78	1.18	1.40	2.05	2.50	2.65	1.30	1.10	.82	.80	.85
14	.60	1.70	1.38	1.42	2.02	2.38	2.50	1.25	1.10	.82	.80	.80
15	.60	1.55	1.28	1.45	2.05	2.55	2.30	1.20	1.08	.82	.80	.65
16	.62	1.62	1.20	1.40	2.20	2.50	2.35	1.20	1.00	.82	.85	.72
17	.62	1.55	1.25	1.40	2.35	2.25	2.25	1.20	1.00	.82	.80	.65
18	.62	1.38	1.35	1.42	2.55	2.10	2.20	1.18	1.00	.82	.70	.65
19	.62	1.32	1.65	1.28	2.58	2.00	2.15	1.18	.95	.82	.90	.60
20	.62	1.45	1.52	1.25	3.00	1.98	2.10	1.15	.95	.82	.88	.60
21	.62	1.42	1.60	1.25	2.85	2.40	2.15	1.12	.95	.82	.95	.65
22	.62	1.48	1.35	1.25	3.00	3.40	2.20	1.05	.95	.82	.95	.75
23	.70	1.42	1.28	1.40	3.00	5.38	2.00	1.05	.92	.82	.88	.75
24	.65	1.58	1.25	1.40	2.85	5.40	1.95	1.05	.90	.82	.95	.75
25	.65	1.18	1.20	1.35	2.72	4.95	1.82	1.02	.90	.82	.90	.75
26	.65	1.02	1.25	1.38	2.75	4.50	1.89	1.02	.90	.82	.90	.75
27	.65	1.20	1.45	1.38	2.65	4.35	1.75	1.02	.90	.80	.75	.75
28	.65	1.18	1.48	1.45	2.55	4.28	1.72	1.10	1.00	.80	.88	.68
29	.65	.....	1.35	1.48	2.85	4.08	1.65	1.10	.95	.80	.88	.68
30	.65	.....	1.18	1.50	2.90	3.85	1.65	1.10	.95	.80	.85	.68
31	.65	.....	1.35	.....	3.00	.....	1.60	1.10	.....	.80	.....	.65
1908.												
1	.70	.65	.65	.75	.75	8.30	2.60	1.15	.95	.85	1.00	.92
2	.70	.65	.65	.75	.75	6.60	2.45	1.12	.92	.95	1.00	.80
3	.70	.65	.65	.80	.75	6.40	2.30	1.10	.88	.98	1.00	.82
4	.70	.65	.60	.75	.80	6.95	2.22	1.08	.88	.98	1.00	.82
5	.70	.65	.60	.80	.78	9.50	2.15	1.08	.85	.95	1.00	.85
6	.70	.70	.65	.78	.75	8.30	2.12	1.05	.80	.95	1.00	.92
7	.75	.70	.70	.80	.80	8.45	2.10	1.05	.80	.92	1.00	1.00
8	.75	.65	.70	.78	.75	7.85	2.00	1.15	.80	.92	1.00	1.00
9	.75	.65	.70	.75	.85	7.32	1.85	1.15	.80	.90	1.00	.95
10	.75	.60	.80	.75	1.15	6.70	1.80	1.12	.80	.90	.98	.92
11	.72	.60	.90	.75	1.05	6.20	1.78	1.10	.80	.90	.98	.90
12	.72	.60	.80	.80	1.35	5.80	1.72	1.12	.80	.90	.98	.95
13	.70	.60	.85	.75	1.28	5.38	1.70	1.30	.78	.90	.98	.78
14	.70	.60	.92	.75	1.40	4.85	1.90	1.28	.78	.90	.95	.80
15	.65	.60	.90	.70	1.35	4.62	2.20	1.22	.78	.92	.92	.85
16	.65	.65	1.10	.75	1.65	4.50	1.90	1.22	.78	1.00	1.00	.75
17	.65	.65	1.00	.75	1.55	4.32	1.85	1.20	.95	1.00	1.15	.75
18	.65	.65	1.00	.75	1.40	4.10	1.80	1.20	1.00	1.00	1.12	.80
19	.70	.65	1.00	.75	1.82	3.95	1.75	1.20	.90	1.00	1.12	.82
20	.70	.65	1.02	.80	1.55	3.70	1.70	1.18	.88	1.05	1.00	.82
21	.65	.65	.95	.75	1.62	3.50	1.65	1.18	.85	1.05	1.00	.82
22	.65	.70	.80	.75	1.75	3.40	1.60	1.18	.82	1.05	1.00	.82
23	.65	.80	.80	.70	1.60	3.28	1.58	1.15	.80	1.05	1.00	.82
24	.65	.80	.68	.78	1.60	3.00	1.52	1.12	.85	1.05	1.00	.82
25	.65	.80	.85	.72	1.85	2.90	1.50	1.10	.90	1.05	1.00	.88
26	.65	.75	.80	.70	1.85	2.80	1.48	1.10	.90	1.05	1.00	.88
27	.65	.75	.80	.70	3.50	2.75	1.45	1.10	.90	1.02	.95	.90
28	.70	.65	.80	.70	2.68	2.72	1.40	1.10	.90	1.02	.95	.90
29	.65	.65	.80	.72	2.48	2.68	1.38	1.00	.88	1.00	.92	.90
30	.65	.....	.80	.75	3.10	2.60	1.30	1.00	.85	1.00	.92	.88
31	.65	.....	.75	.....	4.60	.....	1.20	1.00	.....	1.00	.....	.88

Rating tables for Willow Creek near Augusta, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	6	1.70	41	2.80	89	3.90	144
.70	8	1.80	45	2.90	94	4.00	149
.80	10	1.90	49	3.00	99	4.20	159
.90	13	2.00	53	3.10	104	4.40	169
1.00	16	2.10	57	3.20	109	4.60	179
1.10	19	2.20	61	3.30	114	4.80	191
1.20	22	2.30	65	3.40	119	5.00	203
1.30	25	2.40	69	3.50	124	5.20	215
1.40	29	2.50	74	3.60	129	5.40	227
1.50	33	2.60	79	3.70	134		
1.60	37	2.70	84	3.80	139		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made during 1905–1907 and is well defined.

FOR 1908.

0.60	5	2.00	53	3.40	123	5.60	261
.70	7	2.10	58	3.50	128	5.80	275
.80	10	2.20	63	3.60	134	6.00	289
.90	12	2.30	68	3.70	140	6.20	303
1.00	15	2.40	73	3.80	146	6.40	317
1.10	18	2.50	78	3.90	152	6.60	332
1.20	21	2.60	83	4.00	158	6.80	348
1.30	25	2.70	88	4.20	170	7.00	364
1.40	29	2.80	93	4.40	182	8.00	444
1.50	33	2.90	98	4.60	194	9.00	524
1.60	37	3.00	103	4.80	206	10.00	604
1.70	41	3.10	108	5.00	219		
1.80	45	3.20	113	5.20	233		
1.90	49	3.30	118	5.40	247		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made in 1906–1908 and is fairly well defined below gage height 3.5 feet. Above gage height 6.5 feet the rating curve is a tangent, the difference being 8 per tenth.

Monthly discharge of Willow Creek near Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	8	6	7.0	430	D.
February	260	6	44.5	2,470	A.
March	39	17	25.3	1,560	A
April	33	23	27.7	1,650	A.
May	99	33	65.1	4,000	A.
June	227	52	111	6,600	A.
July	134	37	71.9	4,420	A.
August	37	17	24.2	1,490	A.
September	19	13	16.0	952	A.
October	17	10	11.8	726	C.
November	14	8	11.0	655	C.
December	14	6	9.8	602	D.
The year	260	6	35.4	25,600	

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Monthly discharge of Willow Creek near Augusta, Mont., for 1907 and 1908—Cont'd.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	8	6	6.74	414	D.
February	10	5	6.45	371	D.
March	18	5	10.1	621	D.
April	10	7	8.27	492	D.
May	194	8	40.3	2,480	A.
June	564	83	240	14,300	B.
July	83	21	45.9	2,820	A.
August	25	15	19.1	1,170	A.
September	15	9	11.1	660	A.
October	16	11	14.2	873	B.
November	20	13	15.0	893	B.
December	15	8	11.3	695	B.
The year	594	5	35.7	25,800	

FORD CREEK NEAR AUGUSTA, MONT.

This station, which is located at the ranch of Joseph Ford, 16 miles west of Augusta, was established April 11, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

Ford Creek is a branch of Willow Creek and has no important tributaries. One small irrigation ditch diverts water from the creek above the gage.

The current is swift and the gage heights are but little affected by ice. Conditions of flow are changeable, requiring frequent measurements to properly define the rating curve. The gage datum has remained unchanged.

Discharge measurements of Ford Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	Follansbee and Stewart	15	11.1	1.35	29.1
May 25	J. E. Stewart	20	22.2	1.82	87.0
June 13	do	26	28.8	1.89	91.0
August 2	do	14	16.6	1.40	34.1
September 19	Follansbee and Stewart	12	14.2	1.02	18.2
1908.					
May 5	Raymond Richards	12	8.3	1.11	23.9
May 28	do	24	23.9	1.68	68.0
June 19	J. E. Stewart	23	36.0	1.90	102
July 12	Raymond Richards	13	13.6	1.30	47.1
August 28	do	12	8.4	.91	21.5
October 15	do	12	9.2	.97	24.2

NOTE.—These measurements were made by wading at various sections.

Daily gage height, in feet, of Ford Creek near Augusta, Mont., for 1907 and 1908.

[Joseph Ford, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	1.10	1.10	1.20	2.10	2.20	1.40	1.10	1.05	0.95	0.90
2	.....	.....	1.00	1.10	1.30	2.00	2.18	1.40	1.10	1.05	.95	.90
3	.....	.....	1.00	1.10	1.25	2.02	2.10	1.40	1.10	1.05	.95	.90
4	.....	.....	1.00	1.10	1.20	2.00	2.00	1.40	1.10	1.05	.90	.90
5	.....	1.10	1.00	1.10	1.25	2.00	2.00	1.40	1.10	1.05	.90	.90
6	.....	1.10	1.00	1.10	1.30	2.00	1.90	1.40	1.10	1.05	.90	.90
7	.....	1.10	1.00	1.10	1.40	2.00	1.80	1.35	1.10	1.05	.90	.90
8	.....	1.10	1.00	1.10	1.60	2.00	1.80	1.35	1.10	1.05	.90	.90
9	.....	1.20	1.00	1.15	1.80	2.00	1.85	1.30	1.10	1.05	.90	.90
10	.....	1.20	1.00	1.20	1.78	2.00	1.80	1.30	1.10	1.05	.90	.90
11	.....	1.10	1.00	1.30	1.70	1.92	1.72	1.30	1.10	1.05	.90	.90
12	.....	1.10	1.00	1.35	1.70	1.90	1.70	1.25	1.10	1.05	.90	.90
13	.....	1.10	1.10	1.40	1.70	1.88	1.65	1.20	1.05	1.05	.90	.90
14	.....	1.10	1.00	1.40	1.70	1.80	1.65	1.10	1.05	1.05	.90	.90
15	.....	1.10	1.00	1.40	1.72	1.80	1.65	1.10	1.05	1.05	.90	.90
16	.....	1.10	1.00	1.40	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
17	.....	1.00	1.00	1.40	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
18	.....	1.00	1.10	1.35	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
19	.....	1.00	1.20	1.35	1.95	1.80	1.60	1.10	1.05	1.00	.90	.90
20	1.10	1.00	1.20	1.30	1.95	1.95	1.60	1.10	1.05	1.00	.90	.90
21	1.10	1.00	1.20	1.30	1.85	2.00	1.58	1.10	1.05	1.00	.90	.90
22	1.00	1.00	1.20	1.30	1.85	2.15	1.52	1.10	1.05	1.00	.90	.90
23	1.00	1.00	1.20	1.30	1.80	3.50	1.50	1.10	1.05	1.00	.90	.90
24	.....	1.00	1.20	1.20	1.80	3.25	1.50	1.10	1.05	1.00	.90	.90
25	.....	1.00	1.20	1.20	1.80	2.90	1.48	1.10	1.05	1.00	.90	.90
26	.....	1.00	1.15	1.20	1.80	2.60	1.45	1.10	1.05	1.00	.90	.90
27	.....	1.10	1.10	1.20	1.85	2.48	1.45	1.10	1.05	1.00	.90	.90
28	.....	1.10	1.10	1.40	1.85	2.32	1.45	1.10	1.05	1.00	.90	.90
29	.....	.....	1.10	1.20	1.92	2.25	1.45	1.10	1.05	1.00	.90	.90
30	.....	.....	1.10	1.20	2.05	2.20	1.40	1.10	1.05	.98	.90	.90
31	.....	.....	1.00	.....	2.10	.....	1.35	1.10	.....	.95	.....	.90
1908.												
1	.90	2.00	.70	.70	1.10	3.90	1.50	1.15	.90	.90	.90	.90
2	.90	2.00	.70	.70	1.10	3.60	1.50	1.12	.90	.90	.90	.90
3	.90	2.00	1.10	.70	1.10	3.35	1.40	1.10	.90	.90	.90	.90
4	.90	2.00	1.10	.70	1.10	3.65	1.40	1.05	.90	.90	.90	.90
5	.90	2.00	1.10	.70	1.10	4.40	1.40	1.00	.90	.90	.90	.90
6	.90	.90	.98	.70	1.10	3.80	1.40	1.00	.90	.90	.90	.90
7	.90	.90	.80	.80	1.10	3.75	1.40	1.00	.90	.90	.90	.88
8	.90	.90	.70	.80	1.10	3.55	1.35	1.00	.90	.90	.90	.82
9	.90	.90	.70	.80	1.10	3.10	1.30	1.00	.90	.90	.90	.80
10	.90	.90	.70	.80	1.15	2.70	1.30	1.00	.90	.90	.90	.80
11	.90	.90	.70	.90	1.28	2.45	1.30	1.00	.90	.90	1.05	.80
12	.90	.90	.70	.90	1.38	2.38	1.30	1.00	.90	.90	1.10	.80
13	.90	.90	.70	.90	1.40	2.32	1.30	1.00	.90	.90	.95	.80
14	.90	.90	.80	.90	1.40	2.25	1.30	1.00	.90	.90	.90	.80
15	.90	.90	.70	.90	1.60	2.20	1.30	1.00	.90	.90	.90	.80
16	.90	.90	.70	.95	1.60	2.18	1.30	1.00	.90	.90	.90	.80
17	.90	.85	.70	1.00	1.60	2.10	1.22	1.00	.90	.90	.90	.80
18	.90	.80	.70	1.00	1.60	2.05	1.20	1.00	.90	.90	.90	.80
19	.90	.80	.70	1.00	1.60	1.90	1.20	1.00	.90	.90	.90	.80
20	.90	.80	.70	1.12	1.60	1.80	1.20	1.00	.90	.90	.90	.80
21	.90	.80	.70	1.10	1.60	1.80	1.20	1.00	.90	.90	.90	.80
22	.90	.80	.70	1.10	1.60	1.80	1.20	1.00	.90	.90	.90	.80
23	.90	.80	.70	1.10	1.60	1.78	1.20	1.00	.90	.90	.90	.80
24	.90	.80	.70	1.10	1.58	1.70	1.20	1.00	.90	.90	.90	.80
25	.90	.80	.70	1.10	1.55	1.70	1.20	1.00	.90	.90	.90	.80
26	.90	.70	1.10	1.10	1.70	1.60	1.20	.95	.90	.90	.90	.80
27	.90	.70	.70	1.05	1.70	1.60	1.20	.95	.90	.90	.90	.80
28	.90	.70	.70	1.05	1.70	1.52	1.20	.90	.90	.90	.90	.80
29	.90	.70	.70	1.05	1.70	1.50	1.20	.90	.90	.90	.90	.95
30	1.10	.....	.70	1.10	1.75	1.50	1.15	.90	.90	.90	.90	1.60
31	1.30	.....	1.10	.....	2.48	.....	1.15	.90	.....	.90	.....	1.60

NOTE.—Ice conditions January 1–February 4, 1907; April 28, 1907, slight ice gorge due to slush ice; January 30–February 5, March 3–7, 26, and 30, 1908; also November 11–13 and December 29–31, 1908.

Rating tables for Ford Creek near Augusta, Mont.

JANUARY 1 TO AUGUST 2, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	10	1.70	67	2.40	185	3.20	355
1.10	14	1.80	81	2.50	205	3.40	405
1.20	19	1.90	96	2.60	225	3.60	460
1.30	26	2.00	112	2.70	245	3.80	520
1.40	34	2.10	129	2.80	265	4.00	580
1.50	43	2.20	147	2.90	285	4.20	650
1.60	54	2.30	166	3.00	305	4.40	720

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907 and the form of the 1906 curve. It is fairly well defined between gage heights 1.3 feet and 2.0 feet.

SEPTEMBER 19 TO JUNE 18, 1908.

0.90	12	1.20	29	1.50	51	1.80	82
1.00	17	1.30	36	1.60	60	1.90	96
1.10	23	1.40	43	1.70	70	2.00	112

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined between gage heights 0.9 foot and 2.0 feet. Above gage height 2.0 feet use the preceding curve.

JUNE 19 TO DECEMBER 31, 1908.

0.80	16	1.10	32	1.40	52	1.70	79
0.90	21	1.20	38	1.50	60	1.80	90
1.00	26	1.30	45	1.60	69	1.90	102

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period and is fairly well defined.

Monthly discharge of Ford Creek near Augusta, Mont., for 1907 and 1908.

[Drainage area, 18 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	.....	.....	10.0	0.556	0.64	615	D.
February	19	10	12.6	.700	.73	700	C.
March	19	10	13.1	.728	.84	806	B.
April	34	14	22.3	1.24	1.38	1,330	B.
May	129	19	71.4	3.97	4.58	4,390	A.
June	430	81	142	7.89	8.80	8,450	A.
July	147	30	67.6	3.76	4.34	4,160	A.
August	34	20	24.0	1.33	1.53	1,480	B.
September	22	20	20.4	1.13	1.26	1,210	B.
October	20	12.5	18.6	1.03	1.19	1,140	B.
November	12.5	12	12.0	.667	.74	714	C.
December	12	12	12.0	.667	.77	738	D.
The year	430	.....	35.5	1.97	26.80	25,700	

Monthly discharge of Ford Creek near Augusta, Mont., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
January	12	12	12.0	0.667	0.77	738	D.
February	12	5.3	6.59	.366	.39	379	D.
March	8.5	.....	5.34	.297	.34	328	D.
April	24	5.3	14.5	.806	.90	863	C.
May	201	23	51.8	2.88	3.32	3,190	B.
June	720	60	227	12.6	14.06	13,500	B.
July	60	35	43.7	2.43	2.80	2,690	B.
August	35	21	26.0	1.44	1.66	1,600	B.
September	21	21	21.0	1.17	1.30	1,250	B.
October	21	21	21.0	1.17	1.35	1,290	B.
November	21	21	21.0	1.17	1.30	1,250	C.
December	21	16	17.1	.950	1.10	1,050	D.
The year	720	.....	38.9	2.16	29.29	28,100	

NOTE.—Discharge estimated August 3 to September 18, 1907, and for ice periods.

SMITH CREEK NEAR AUGUSTA, MONT.

This station, which is located 1 mile above J. W. Nixon's ranch, 16 miles southwest of Augusta, Mont., was established April 14, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

The ordinary summer flow is practically all used for irrigation, but no water is diverted above the gaging station.

Measurements can be made only by wading and conditions for obtaining accurate discharge data are good at low and medium stages; no measurements can be made at flood stages. Gage heights are not affected by ice. The gage datum has not been changed since the station was established. The discharge curves plotted for this station are shown in figure 1, page 23.

Discharge measurements of Smith Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	Follansbee and Stewart	23	22.2	1.16	41.9
May 24	J. E. Stewart	30	36.2	1.51	107
June 12	do	26	28.3	1.43	80.0
August 1	do	26	23.1	1.22	35.2
September 18	Follansbee and Stewart	18	17.3	1.06	17.5
1908.					
May 5	Stewart and Richards	18	17.8	1.09	19.8
May 28	Raymond Richards	37	44.0	1.80	149
June 18	J. E. Stewart	25	31.6	1.14	97.8
July 12	Raymond Richards	22	17.4	.80	38.9
August 29	do	23	12.6	.62	18.4
October 16	do	28	23.6	.98	53.9

NOTE.—These measurements were made by wading at various sections.

Daily gage height, in feet, of Smith Creek near Augusta, Mont., for 1907 and 1908.

[Mrs. J. W. Nixon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.95	0.95	0.95	1.05	1.2	1.75	1.7	1.2	1.1	1.0	1.0	1.0
2	.95	.95	.95	1.05	1.2	1.7	1.65	1.2	1.1	1.0	1.0	1.0
3	.95	1.0	.9	1.1	1.2	1.7	1.6	1.2	1.1	1.0	1.0	1.0
4	.95	1.0	.9	1.2	1.1	1.6	1.6	1.2	1.1	1.0	1.0	1.0
5	.9	1.0	.9	1.2	1.1	1.6	1.5	1.2	1.1	1.0	1.0	1.0
6	.9	1.0	.9	1.2	1.2	1.6	1.5	1.15	1.1	1.0	1.0	1.0
7	.9	1.05	.9	1.2	1.2	1.6	1.5	1.15	1.1	1.0	1.0	1.0
8	.9	1.05	.9	1.2	1.25	1.65	1.5	1.15	1.1	1.0	1.0	1.0
9	.9	1.05	.9	1.2	1.25	1.5	1.5	1.1	1.1	1.0	1.0	1.0
10	.9	1.0	.9	1.2	1.45	1.5	1.5	1.1	1.1	1.0	1.0	1.0
11	.9	1.0	.9	1.2	1.6	1.5	1.4	1.1	1.1	1.0	1.0	1.0
12	.9	.9	.9	1.2	1.45	1.55	1.4	1.1	1.05	1.0	1.0	1.0
13	.9	.9	.9	1.2	1.45	1.4	1.4	1.1	1.05	1.0	1.0	1.0
14	.9	.9	.9	1.15	1.45	1.4	1.3	1.1	1.05	1.0	1.0	1.0
15	.9	.9	.9	1.15	1.35	1.45	1.3	1.1	1.05	1.0	1.0	1.0
16	.9	.9	.9	1.15	1.3	1.4	1.3	1.1	1.05	1.0	1.0	1.0
17	.9	.9	1.0	1.15	1.38	1.35	1.3	1.1	1.05	1.0	1.0	1.0
18	.9	.9	1.1	1.15	1.45	1.3	1.3	1.1	1.05	1.0	1.0	1.0
19	.9	.9	1.1	1.15	1.4	1.3	1.3	1.1	1.05	1.0	1.0	1.0
20	.95	.9	1.1	1.15	1.8	1.3	1.3	1.1	1.05	1.0	1.0	1.0
21	.95	.9	1.1	1.1	1.7	1.4	1.3	1.1	1.05	1.0	1.0	1.0
22	.95	.9	1.1	1.1	1.7	2.2	1.3	1.1	1.05	1.0	1.0	1.0
23	.95	.9	1.1	1.2	1.6	3.7	1.3	1.1	1.05	1.0	1.0	1.0
24	.95	.9	1.05	1.2	1.5	2.8	1.3	1.1	1.05	1.0	1.0	1.0
25	.95	.9	1.05	1.15	1.5	2.15	1.3	1.1	1.05	1.0	1.0	1.0
26	.9	.9	1.0	1.15	1.6	2.2	1.3	1.1	1.05	1.0	1.0	1.0
27	.9	.95	1.0	1.2	1.6	2.2	1.3	1.1	1.05	1.0	1.0	1.0
28	.9	.95	1.0	1.2	1.6	2.1	1.2	1.1	1.05	1.0	1.0	1.0
29	.9	.....	1.0	1.2	1.7	1.9	1.2	1.1	1.05	1.0	1.0	1.0
30	.9	.....	1.05	1.2	1.75	1.9	1.2	1.1	1.05	1.0	1.0	1.0
31	.9	.....	1.05	.....	1.8	.....	1.2	1.1	.....	1.0	.....	1.0
1908.												
1	1.0	1.0	1.0	1.0	1.1	3.25	.9	.65	.6	.6	.75	.7
2	1.0	1.0	1.0	1.0	1.1	2.3	.9	.6	.6	.65	.75	.7
3	1.0	1.0	1.0	1.0	1.1	3.6	.85	.6	.6	.65	.75	.7
4	1.0	1.0	1.0	1.0	1.1	3.0	.8	.6	.6	.65	.75	.7
5	1.0	1.0	1.0	1.0	1.1	3.65	.8	.6	.6	.70	.75	.7
6	1.0	1.0	1.0	1.0	1.1	2.8	.8	.6	.6	.75	.75	.7
7	1.0	1.0	1.0	1.0	1.1	2.5	.8	.6	.6	.75	.75	.7
8	1.0	1.0	1.0	1.0	1.1	2.4	.8	.6	.6	.75	.75	.7
9	1.0	1.0	1.0	1.0	1.2	2.0	.8	.6	.6	.8	.75	.7
10	1.0	1.0	1.0	1.0	1.4	1.8	.8	.6	.55	.8	.75	.7
11	1.0	1.0	1.0	1.0	1.5	1.7	.8	.6	.55	.85	.75	.65
12	1.0	1.0	1.0	1.0	1.5	1.6	.8	.65	.55	.9	.75	.65
13	1.0	1.0	1.05	1.0	1.5	1.5	.8	.65	.55	.9	.75	.6
14	1.0	1.0	1.05	1.0	1.5	1.3	.8	.7	.55	1.0	.75	.6
15	1.0	1.0	1.05	1.0	1.6	1.2	.8	.75	.55	1.0	.7	.6
16	1.0	1.0	1.0	1.0	1.6	1.2	.8	.7	.55	1.0	.7	.6
17	1.0	1.0	1.0	1.0	1.55	1.1	.8	.65	.6	1.0	.7	.6
18	1.0	1.0	1.0	1.0	1.5	1.1	.8	.65	.65	1.0	.7	.6
19	1.0	1.0	1.0	1.1	1.5	1.1	.75	.6	.7	1.0	.7	.6
20	1.0	1.0	1.0	1.1	1.6	1.1	.75	.6	.7	.95	.7	.6
21	1.0	1.0	1.0	1.1	1.6	1.05	.75	.6	.65	.9	.7	.6
22	1.0	1.0	1.0	1.1	1.6	1.05	.75	.6	.65	.8	.7	.6
23	1.0	1.0	1.0	1.1	1.6	1.0	.75	.6	.6	.8	.7	.6
24	1.0	1.0	1.0	1.1	1.6	1.0	.75	.6	.6	.8	.7	.6
25	1.0	1.0	1.0	1.1	1.7	1.0	.75	.6	.6	.8	.7	.6
26	1.0	1.0	1.0	1.1	1.75	1.0	.7	.6	.6	.8	.7	.6
27	1.0	1.0	1.0	1.1	1.8	1.0	.7	.6	.6	.8	.7	.6
28	1.0	1.0	1.0	1.1	1.8	1.0	.7	.6	.6	.8	.7	.6
29	1.0	1.0	1.0	1.1	1.8	1.0	.65	.6	.6	.75	.7	.6
30	1.0	.....	1.0	1.1	1.9	1.0	.65	.6	.6	.75	.7	.6
31	1.0	.....	1.0	.....	2.75	.....	.65	.6	.....	.75	.....	.6

Rating tables for Smith Creek near Augusta, Mont.

APRIL 16, 1906, TO JUNE 23, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	6	1.60	123	2.40	354	3.20	631
.90	12	1.70	148	2.50	387	3.30	666
1.00	20	1.80	175	2.60	421	3.40	701
1.10	31	1.90	203	2.70	456	3.50	736
1.20	45	2.00	232	2.80	491	3.60	771
1.30	61	2.10	261	2.90	526	3.70	806
1.40	79	2.20	291	3.00	561		
1.50	100	2.30	322	3.10	596		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eleven discharge measurements made during the above period, and is well defined between gage heights 0.9 foot and 1.6 feet.

JUNE 24, 1907, TO JUNE 5, 1908.

1.00	13	1.70	132	2.40	335	3.20	613
1.10	21	1.80	158	2.50	368	3.40	687
1.20	32	1.90	185	2.60	402	3.60	761
1.30	47	2.00	213	2.70	436	3.80	835
1.40	64	2.10	242	2.80	470		
1.50	84	2.20	272	2.90	505		
1.60	107	2.30	303	3.00	540		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period and the form of the previous curve, and is well defined between gage heights 1.0 foot and 1.9 feet.

JUNE 6, 1908, TO OCTOBER 13, 1908.

0.60	17	1.20	107	1.80	242	2.40	404
.70	28	1.30	127	1.90	268	2.50	432
.80	40	1.40	148	2.00	295	2.60	460
.90	54	1.50	170	2.10	322	2.70	488
1.00	70	1.60	193	2.20	349	2.80	517
1.10	88	1.70	217	2.30	376		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period, and is well defined below gage height 1.3 feet.

OCTOBER 14, 1908, TO DECEMBER 31, 1908.

0.60	12	0.80	30	0.90	42	1.00	57
.70	20						

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on one discharge measurement made during the above period and the shape of the previous curve, and is not well defined.

Monthly discharge of Smith Creek near Augusta, Mont., for 1907 and 1908.

[Drainage area, 26 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	16	12	13.3	0.512	0.59	818	B.
February	25	12	15.7	.604	.63	872	B.
March	31	12	18.9	.727	.84	1,160	B.
April	45	25	40.2	1.55	1.73	2,390	A.
May	175	31	93.3	3.59	4.14	5,740	A.
June	806	61	171	6.58	7.34	10,200	B.
July	132	32	62.8	2.42	2.79	3,860	B.
August	32	21	23.3	.896	1.03	1,430	C.
September	21	17	18.5	.712	.79	1,100	C.
October	13	13	13.0	.500	.58	799	D.
November	13	13	13.0	.500	.56	774	D.
December	13	13	13.0	.500	.58	799	D.
The year	806	12	41.3	1.59	21.60	29,900	
1908.							
January	13	13	13.0	.500	.58	799	D.
February	13	13	13.0	.500	.54	748	D.
March	17	13	13.4	.515	.59	824	D.
April	21	13	16.2	.623	.70	964	C.
May	453	21	96.8	3.72	4.29	5,950	A.
June	780	70	230	8.85	9.87	13,700	A.
July	54	22	36.9	1.42	1.64	2,270	B.
August	34	17	19.1	.735	.85	1,170	C.
September	28	14	17.5	.673	.75	1,040	C.
October	57	17	37.6	1.45	1.67	2,310	B.
November	25	20	22.3	.858	.96	1,330	C.
December	20	12	15.0	.577	.67	922	D.
The year	780	12	44.2	1.70	23.11	32,000	

MARIAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The headwaters of Marias River rise on the eastern slope of the main divide of the Rocky Mountains at an elevation of over 8,000 feet and flow in an easterly direction through a region of elevated plains and prairies. Marias River proper is formed by the union of Cutbank and Two Medicine rivers, which meet at the eastern boundary of the Blackfeet Indian Reservation. From this junction to the Missouri, which it enters 14 miles below Fort Benton, its length is about 110 miles and its fall does not exceed 5 feet per mile. Its principal tributaries are Willow and Cottonwood creeks, which enter from the north, and Teton River, which comes in from the south.

The general altitude of this country is from 3,000 to 4,000 feet, the plains rising by gentle terraces toward the mountains to elevations of about 5,000 feet. Grass is abundant and the region is devoted to grazing. Considerable spruce and pine timber is found at the headwaters in the mountains, but the remainder of the basin is bare except for fringes and small groves along the streams.

The mean annual rainfall varies from about 60 inches in the mountains to 12 inches near the mouth of the river, the average for the plains section being about 16 inches. The streams are icebound from December until early in March, and this is the season of least flow.

Irrigation has been practiced to a slight extent for a number of years in the valleys of the tributaries, and three large irrigation projects are now under construction. One is being constructed by the United States Reclamation Service, and the other two under the Carey Act. Altogether about 450,000 acres will be reclaimed. The basin affords a number of excellent reservoir sites, which will be utilized in storing the flood waters of the upper tributaries from which the principal water supply for these projects will come.

The great fall and the abundant water supply of the upper tributaries of Marias River also afford favorable conditions for water-power development.

Run-off records in this basin extend back to 1902. The wettest year since that time was 1903, and the driest was 1905.

The following gaging stations have been maintained in this river basin:

Cutbank Creek at Cutbank, Mont., 1905–1908.
Marias River near Shelby, Mont., 1902–1907.
Two Medicine Creek near Midvale, Mont., 1902–3.
Two Medicine Creek at Family, Mont., 1907–8.
Badger Creek near Family, Mont., 1907–8.
Birch Creek near Dupuyer, Mont., 1907–8.
Dupuyer Creek at Dupuyer, Mont., 1908.
Teton River at Chouteau, Mont., 1905–6.
Teton River near Belleview, Mont., 1905–6 and 1908.

CUTBANK CREEK AT CUTBANK, MONT.

This station, which is located one-half mile southwest of Cutbank, one-fourth mile below the Great Northern Railway bridge, and 12 miles above the mouth of Two Medicine, was established August 4, 1905, to obtain data for use in connection with irrigation projects under consideration by the United States Reclamation Service.

The intake of the Great Northern Railway's pumping station is located a hundred yards above the gage. The average quantity pumped is about 14,000 gallons an hour for eighteen hours a day—equivalent to a continuous flow of 0.4 second-foot.

The datum of the gage has not been changed since the station was established. The records during the winter months are somewhat affected by ice. The results taken as a whole can be considered as good.

Discharge measurements of Cutbank Creek at Cutbank, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 9	J. B. Pierson	65	78	3.51	349
May 21	J. E. Stewart	110	164	4.02	754
June 12	J. B. Pierson	110	175	4.04	798
June 27	Follansbee and Pierson	125	235	4.29	1,020
July 13	J. B. Pierson	108	150	3.85	631
July 26	do	101	102	3.56	369
August 6	do	90	75	3.39	234
August 21 [a]	Follansbee and Pierson	80	45.7	3.17	107
October 17	J. E. Stewart	60	35.8	3.05	77.0
1908.					
April 21	A. F. Huch	106	120	3.69	423
May 21	do	105	109	3.72	390
June 21	do	133	221	3.89	755
August 6 [a]	Stewart and Huch	100	70	3.07	129
August 30 [a]	J. E. Stewart	64	57.4	2.91	69.9

[a] Made by wading.

Daily gage height, in feet, of Cutbank Creek at Cutbank, Mont., for 1907 and 1908.

[Frank Mason and Conrad Peters, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1			4.2	4.4	3.5	4.05	4.25	3.4	3.4	3.2	3.0	2.9
2			4.1	4.1	3.5	4.2	4.1	3.4	3.3	3.2	3.1	3.0
3	4.0			4.0	3.5	4.4	4.1	3.4	3.3	3.3	2.9	2.9
4				3.85	3.5	4.25	4.15	3.3	3.2	3.2	2.9	2.9
5				3.8	3.5	4.1	4.1	3.3	3.3	3.1	3.0	3.1
6				3.65	3.45	4.1	4.05	3.4	3.2	3.2	2.9	3.05
7		3.9	3.9	3.6	3.45	4.15	4.0	3.35	3.3	3.1	2.9	3.1
8				3.5	3.5	4.3	3.9	3.3	3.2	3.1	3.0	
9				3.65	3.55	4.4	3.9	3.3	3.3	3.2	2.9	
10	3.7			3.65	3.6	4.25	3.9	3.3	3.2	3.1	2.9	
11				3.8	3.75	4.1	3.9	3.3	3.3	3.1	3.0	
12		4.8		3.65	3.9	4.0	3.9	3.3	3.3	3.2	3.0	
13		4.75		3.55	3.9	4.1	3.8	3.3	3.4	3.1	3.05	
14		4.8	3.5	3.5	3.8	4.1	3.8	3.2	3.3	3.1	3.2	
15		4.85		3.55	3.75	4.0	3.8	3.2	3.5	3.2	3.0	
16		4.75		3.55	3.9	4.0	3.7	3.2	3.4	3.1	2.95	
17	3.3	4.6		3.5	4.2	3.9	3.7	3.2	3.5	3.05	3.0	
18		4.45		3.5	4.35	3.8	3.7	3.2	3.4	3.1	2.95	
19		4.15		3.5	4.2	3.85	3.6	3.2	3.45	3.0	2.95	
20		4.1		3.45	4.05	4.0	3.6	3.2	3.3	3.0	3.0	
21		4.05		3.4	4.0	4.0	3.6	3.2	3.4	3.1	2.9	
22		4.0		3.4	4.0	4.5	3.6	3.2	3.3	3.0	2.95	
23		4.2		3.45	4.0	7.1	3.6	3.1	3.35	3.0	3.0	
24	4.2	4.1	3.65	3.5	3.9	5.3	3.5	3.1	3.3	3.1	2.9	
25		3.95	3.45	3.5	3.85	4.6	3.5	3.1	3.4	3.0	2.85	
26		3.85	3.4	3.4	3.8	4.35	3.5	3.2	3.3	3.0	3.0	
27		3.8	3.45	3.4	3.7	4.25	3.4	3.2	3.4	3.1	2.85	
28		4.15	3.35	3.4	3.7	4.35	3.4	3.3	3.3	3.0	2.85	
29			3.4	3.4	3.7	4.5	3.4	3.3	3.4	3.0	3.1	
30			3.25	3.4	3.8	4.4	3.4	3.4	3.3	3.1	3.0	
31	4.1		3.35		3.9		3.4	3.4		3.0		
1908.												
1				3.25	3.5	4.4	3.6	3.15	2.9	3.1	3.0	3.2
2				3.35	3.5	5.1	3.6	3.05	2.9	3.1	3.0	3.2
3				3.4	3.5	4.9	3.6	3.0	2.9	3.1	3.0	3.25
4				3.25	3.6	4.75	3.6	3.0	2.9	3.1	3.0	3.3
5				3.4	3.6	[a]8.5	3.6	3.0	2.9	3.05	3.0	3.4
6				3.45	3.65	9.0	3.6	3.0	2.9	3.0	3.0	3.4
7				3.55	3.7	7.2	3.55	3.0	2.9	3.0	3.0	3.4
8				3.4	3.8	5.7	3.5	3.0	2.9	3.0	3.0	3.4
9				3.3	4.0	5.15	3.5	3.0	2.9	3.0	3.0	3.5
10				3.25	3.85	4.8	3.5	3.0	2.9	3.0	3.0	3.5

[a] Maximum recorded gage height for June 5, 1908, was 10.0 feet.

Daily gage height in feet, of Cutbank Creek at Cutbank, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
11				3.25	3.8	4.7	3.5	3.0	2.8	3.0	3.0	3.5
12				3.3	3.9	4.6	3.5	3.0	2.8	3.0	3.0	3.5
13				3.35	4.1	4.5	3.5	3.0	2.8	3.0	3.0	3.5
14				3.4	4.0	4.35	3.5	3.1	2.8	3.0	3.0	3.5
15				3.5	4.1	4.25	3.5	3.1	2.8	3.0	3.1	3.5
16				3.4	4.2	4.15	3.5	3.1	2.8	3.0	3.15	3.4
17				3.4	4.05	4.15	3.5	3.1	2.9	3.0	3.2	3.4
18				3.4	3.9	4.1	3.5	3.0	3.0	3.0	3.2	3.5
19				3.5	3.8	4.0	3.5	3.0	3.0	3.0	3.2	3.5
20				3.6	3.8	4.0	3.4	3.0	3.0	3.1	3.2	3.5
21				3.7	3.75	3.95	3.4	3.1	2.9	3.1	3.2	3.5
22				3.8	3.7	3.8	3.4	3.1	2.9	3.0	3.2	3.6
23				3.8	3.7	3.8	3.4	3.1	2.9	3.0	3.2	3.6
24				3.8	3.7	3.7	3.4	3.1	2.9	3.0	3.2	3.6
25				3.8	3.75	3.7	3.3	3.0	3.0	3.0	3.1	3.6
26				3.7	3.9	3.7	3.3	3.0	3.0	3.0	3.1	3.5
27				3.65	3.9	3.7	3.3	3.0	3.0	3.0	3.1	3.6
28				3.6	3.9	3.7	3.2	3.0	3.05	3.0	3.2	3.6
29				3.6	3.9	3.65	3.2	2.95	3.1	3.0	3.25	3.7
30				3.55	3.8	3.6	3.2	2.9	3.1	3.0	3.2	3.7
31					3.95		3.2	2.9		3.0		3.6

NOTE.—Creek frozen entirely across January 1 to February 11, 1907. March 3–21, 1907, it was full of anchor ice. Ice conditions December 8, 1907, to March 31, 1908, and December, 1908.

Rating tables for Cutbank Creek at Cutbank, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	60	4.00	750	5.00	1,780	6.00	3,020
3.10	84	4.10	845	5.10	1,890	6.20	3,300
3.20	125	4.20	940	5.20	2,010	6.40	3,580
3.30	180	4.30	1,040	5.30	2,130	6.60	3,860
3.40	248	4.40	1,140	5.40	2,250	6.80	4,140
3.50	322	4.50	1,240	5.50	2,370	7.00	4,420
3.60	400	4.60	1,345	5.60	2,500	7.20	4,700
3.70	483	4.70	1,450	5.70	2,630		
3.80	569	4.80	1,560	5.80	2,760		
3.90	658	4.90	1,670	5.90	2,890		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907 and is well defined between gage heights 3.0 feet and 4.5 feet.

APRIL 1 TO JUNE 4, 1908.

[Indirect method for shifting channels used.]

JUNE 5 TO DECEMBER 31, 1908.

2.80	45	3.70	589	4.60	1,460	6.00	3,110
2.90	65	3.80	676	4.70	1,570	6.20	3,370
3.00	94	3.90	765	4.80	1,680	6.40	3,630
3.10	138	4.00	855	4.90	1,790	6.60	3,890
3.20	197	4.10	945	5.00	1,900	6.80	4,150
3.30	264	4.20	1,040	5.20	2,140	7.00	4,410
3.40	340	4.30	1,140	5.40	2,380	8.00	5,810
3.50	420	4.40	1,240	5.60	2,620	9.00	7,310
3.60	503	4.50	1,350	5.80	2,860		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and the form of the previous curve and is not well defined.

Daily discharge, in second-feet, of Cutbank Creek at Cutbank, Mont., for 1908.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	105	255	1,020	11	105	475	.....	21	425	400	.....
2	151	255	2,000	12	125	560	.....	22	520	385	.....
3	180	255	1,780	13	151	740	.....	23	520	380	.....
4	105	320	1,600	14	180	650	.....	24	520	375	.....
5	180	320	.....	15	250	740	.....	25	520	400	.....
6	214	360	.....	16	180	815	.....	26	420	545	.....
7	290	400	.....	17	180	680	.....	27	377	560	.....
8	180	485	.....	18	180	545	.....	28	330	560	.....
9	125	660	.....	19	250	460	.....	29	330	560	.....
10	105	515	.....	20	330	460	.....	30	290	475	.....
								31	.....	605	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Cutbank Creek at Cutbank, Mont., for 1907 and 1908.

[Drainage area, 971 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	.....	.....	200	0.206	0.24	12,300	D.
February	.....	.....	690	.710	.74	38,300	D.
March	.....	.....	260	.268	.31	16,000	D.
April	1,140	248	410	.422	.47	24,400	A.
May	1,090	285	561	.578	.67	34,500	A.
June	4,560	569	1,090	1.12	1.25	64,900	A.
July	990	248	536	.552	.64	33,000	A.
August	248	84	165	.170	.20	10,100	A.
September	322	125	205	.212	.24	12,200	A.
October	180	60	89.0	.092	.11	5,470	B.
November	125	44	58.6	.060	.07	3,490	D.
December	.....	.....	53.0	.055	.06	3,260	D.
The year	4,560	.....	360	.370	5.00	258,000	
1908.							
April	520	105	261	.269	.30	15,500	D.
May	815	255	490	.505	.58	30,100	D.
June	7,310	503	1,630	1.68	1.87	97,000	C
July	503	197	381	.392	.45	23,400	B.
August	168	65	106	.109	.13	6,520	B.
September	138	45	73.4	.076	.08	4,370	C.
October	138	94	103	.106	.12	6,330	B.
November	230	94	141	.145	.16	8,390	B.
December	.....	.....	125	.129	.15	7,690	D.
The period	.....	.....	.....	.....	.....	199,000	

MARIAS RIVER NEAR SHELBY, MONT.

This station, which is located at the highway bridge near James A. Johnson's ranch, 7 miles south of Shelby, Mont., was established April 4, 1902, to obtain data for use in connection with irrigation projects. It was discontinued January 12, 1908.

No important tributaries enter near the gaging station. The total drainage area is 2,610 square miles. Very little water is taken from the main stream above the station on account of its high banks and the consequent difficulty of diversion. Several small irrigation canals

receive their supply from some of the upper tributaries, especially Birch and Dupuyer creeks.

The conditions for obtaining accurate discharge data are good, except during part of the winter months, when ice exists. The gage datum has never been changed. The discharge curve is shown in figure 2, page 24.

Discharge measurements of Marias River near Shelby, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	Robert Follansbee	200	809	5.26	4,520
June 12	J. B. Pierson	200	861	5.23	4,230
June 27	Follansbee and Pierson	246	1,250	6.91	7,810
July 13	J. B. Pierson	190	721	4.74	2,910
July 27	do	170	574	4.00	1,610
August 21	Follansbee and Pierson	150	405	3.18	664
October 18	J. E. Stewart	140	350	2.79	474

Daily gage height, in feet, of Marias River near Shelby, Mont., for 1907 and 1908.

[James A. Johnson, observer.]

Day.	1907.								1908.
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
1	.....	5.05	6.4	3.8	3.7	3.2	2.8	2.7	2.5
2	.....	5.7	5.85	3.8	3.6	3.2	2.8	2.7	2.5
3	.....	6.3	5.65	3.8	3.5	3.1	2.9	2.7	2.5
4	.....	6.1	6.2	3.7	3.5	3.1	2.9	2.7	2.4
5	.....	5.8	5.85	3.7	3.5	3.1	2.9	2.6	2.4
6	.....	5.5	5.4	3.6	3.6	3.0	2.9	2.6	2.4
7	.....	6.05	5.1	3.6	3.5	2.9	2.9	2.6	2.4
8	.....	6.3	5.6	3.6	3.5	2.9	2.9	2.6	2.4
9	.....	6.65	4.9	3.5	3.4	2.9	2.9	2.6	2.4
10	.....	5.8	4.85	3.6	3.3	2.9	2.9	2.7	2.4
11	.....	5.35	4.8	3.7	3.3	2.9	2.9	2.7	2.4
12	.....	5.15	4.75	3.7	3.3	3.0	2.8	2.6	.....
13	.....	5.3	4.7	3.6	3.2	3.0	2.8	2.6	.....
14	.....	5.45	4.6	3.5	3.3	3.0	2.8	2.6	.....
15	.....	5.35	4.55	3.5	3.3	2.9	2.8	2.6	.....
16	.....	5.5	4.4	3.4	3.3	2.9	2.8	2.6	.....
17	.....	5.1	4.3	3.5	3.3	2.8	2.8	2.6	.....
18	.....	4.8	4.4	3.4	3.4	2.8	2.8	2.6	.....
19	.....	4.6	4.4	3.3	3.5	2.8	2.8	2.5	.....
20	5.3	4.65	4.3	3.3	3.4	2.8	2.7	2.5	.....
21	5.4	4.9	4.3	3.2	3.4	2.8	2.7	2.5	.....
22	5.3	6.0	4.5	3.2	3.3	2.8	2.7	2.5	.....
23	5.05	12.1	4.4	3.1	3.3	2.8	2.7	2.5	.....
24	5.05	14.9	4.3	3.2	3.3	2.8	2.7	2.5	.....
25	4.6	10.1	4.2	3.3	3.3	2.8	2.7	2.5	.....
26	4.35	7.15	4.2	3.3	3.3	2.8	2.7	2.6	.....
27	4.3	6.9	4.0	3.4	3.2	2.8	2.7	2.6	.....
28	4.35	7.4	3.95	3.4	3.2	2.8	2.8	2.6	.....
29	4.45	7.0	3.95	3.4	3.2	2.8	2.8	2.5	.....
30	4.55	6.6	3.9	3.5	3.3	2.8	2.8	2.5	.....
31	5.15	.....	3.8	3.6	.....	2.8	.....	2.5	.....

Rating tables for Marias River near Shelby, Mont.

JUNE 27, 1907, TO JANUARY 11, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	250	3.50	1,020	4.60	2,650	5.70	4,920
2.50	290	3.60	1,130	4.70	2,840	5.80	5,140
2.60	335	3.70	1,250	4.80	3,030	5.90	5,370
2.70	385	3.80	1,370	4.90	3,230	6.00	5,600
2.80	440	3.90	1,500	5.00	3,430	6.20	6,060
2.90	500	4.00	1,640	5.10	3,630	6.40	6,520
3.00	570	4.10	1,790	5.20	3,840	6.60	7,000
3.10	640	4.20	1,950	5.30	4,050	6.80	7,480
3.20	720	4.30	2,120	5.40	4,260	7.00	7,970
3.30	810	4.40	2,290	5.50	4,480		
3.40	910	4.50	2,470	5.60	4,700		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1907, and is well defined between gage heights 2.7 feet and 8.0 feet.

MAY 20, 1907, TO JUNE 26, 1907.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Marias River near Shelby, Mont., for 1907.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1	.....	3,960	11	.....	4,500	21	4,840	3,300
2	.....	5,400	12	.....	4,050	22	4,580	5,700
3	.....	6,800	13	.....	4,350	23	4,030	21,600
4	.....	6,350	14	.....	4,700	24	4,020	29,500
5	.....	5,600	15	.....	4,350	25	3,100	16,000
6	.....	5,400	16	.....	4,670	26	2,610	8,340
7	.....	6,150	17	.....	3,800	27	2,520	.....
8	.....	6,750	18	.....	3,190	28	2,580	.....
9	.....	7,580	19	.....	2,800	29	2,770	.....
10	.....	5,550	20	4,600	2,900	30	2,950	.....
						31	4,170	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Marias River near Shelby, Mont., for 1907 and 1908.

[Drainage area, 2,610 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
May 20–31	4,840	2,520	3,560	1.36	0.61	84,700	A.
June	29,500	2,800	7,160	2.74	3.06	426,000	A.
July	6,520	1,370	2,990	1.14	1.31	184,000	A.
August	1,370	640	1,020	.391	.45	62,700	A.
September	1,250	720	889	.341	.38	52,900	A.
October	720	440	508	.195	.22	31,200	B.
November	500	385	443	.170	.19	26,400	C.
December	385	290	330	.126	.15	20,300	D.
The period	.....	.....	.....	.....	.....	888,000	
1908.							
January 1–11	290	250	261	.100	.04	5,690	D.

NOTE.—There were slight ice conditions in December, 1907.

TWO MEDICINE RIVER AT FAMILY, MONT.

This station, which is located at the Holy Family Mission, 16 miles southeast of Browning, Mont., and about 6 miles above the mouth of Badger Creek, the nearest tributary, was established April, 1907, to determine the amount of water available for irrigation.

The United States Reclamation Service has under consideration a project which will use about 200 second-feet of water for irrigating land north of the stream for the Blackfeet Indians. The water will be diverted near the mouth of Little Badger Creek, a small tributary entering from the south above the station. A storage reservoir will be built at Two Medicine Lake near the headwaters of the stream to augment the low-water flow. The only diversion from this stream at present is that made by a ditch which supplies water for about 100 acres of land on the farm at the Holy Family Mission. It heads about 2 miles above the gage.

The datum of the gage was lowered 0.95 foot July 21, 1908. The results are good at this station except during the winter months, when they are affected by ice.

Discharge measurements of Two Medicine River at Family, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 26	Robert Follansbee	84	222	3.05	488
May 18	J. E. Stewart	75	423	4.85	2,090
June 11	J. B. Pierson	85	460	4.65	2,110
July 12	do	88	311	3.45	1,070
August 12	do	43	135	2.29	265
September 2	do	43	132	2.32	263
1908.					
April 13	A. F. Huch	86	307	3.20	770
May 18	do	89	366	3.81	1,320
July 21[a]	Stewart and Huch	100	138	2.68	375
August 18[a]	do	64	56.3	2.00	103
October 1[a]	A. F. Huch	65	54.0	1.99	100

[a] Made by wading.

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1907 and 1908.

[William Ripperger and Mike Kittson, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1					3.05	5.10		2.60	2.35	2.20	1.60	1.60
2					3.00	5.60	4.35	2.60	2.30	2.15	1.60	1.60
3					3.10	5.30	4.25	2.60	2.30	2.10	1.60	1.55
4					3.05	4.90	4.40	2.60	2.28	2.05	1.60	1.55
5					3.20	4.80	4.30	2.55	2.25	2.05	1.60	1.50
6					3.18	4.90	3.95	2.50	2.28	2.00	1.60	1.50
7					3.30	4.95	3.80	2.45	2.30	1.95	1.60	1.45
8					4.50	5.60	3.55	2.40	2.30	1.95	1.60	1.40
9					4.15	5.30	3.55	2.35	2.30	1.90	1.60	1.40
10					4.80	5.00	3.55	2.35	2.30	1.90	1.60	1.40
11					5.00	4.70	3.50	2.35	2.35	1.90	1.60	1.55
12					4.60	4.60	3.50	2.30	2.40	1.85	1.60	1.55
13					4.10	4.65	3.50	2.25	2.40	1.85	1.60	1.55
14					4.50	4.55	3.40	2.20	2.35	1.85	1.60	1.55
15					4.70	4.40	3.30	2.20	2.35	1.85	1.60	1.55

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1907 and 1908— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16					5.50	4.40	3.25	2.15	2.35	1.80	1.60	1.55
17					5.50	4.20	3.15	2.10	2.38	1.80	1.60	1.55
18					4.92	4.15	3.15	2.10	2.40	1.80	1.60	1.55
19					4.75	4.25	3.00	2.05	2.40	1.80	1.60	1.55
20					4.80	4.40	2.95	2.02	2.40	1.80	1.60	1.55
21					4.70	4.50	3.00	2.00	2.35	1.75	1.60	1.55
22					4.70	5.80	3.00	2.00	2.35	1.75	1.65	1.55
23					4.35	8.40	2.95	1.95	2.35	1.75	1.65	1.55
24					4.05	6.50	2.90	1.92	2.30	1.75	1.65	1.55
25					3.95	5.40	2.85	2.00	2.30	1.70	1.65	1.55
26				3.05	3.80	5.05	2.80	1.98	2.28	1.70	1.65	1.55
27				3.05	3.80	5.05	2.75	2.05	2.25	1.70	1.65	1.55
28				3.02	3.82	5.20	2.70	2.20	2.25	1.65	1.65	1.55
29				2.90	4.25	5.15	2.70	2.30	2.25	1.65	1.65	1.55
30				3.00	4.45	4.90	2.70	2.35	2.25	1.65	1.65	1.55
31					4.60		2.65	2.40		1.65		1.55
1908.												
1	1.4		1.3	1.75	2.80	6.20	3.0	2.5	2.1	2.0		
2	1.4		1.3	1.75	2.50	6.40	3.0	2.45	2.0	2.1		
3	1.4		1.3	1.83	2.60	6.80	3.0	2.35	2.1	2.0		
4	1.4		1.3	1.83	2.60	7.90	2.95	2.2	2.15	2.0		
5	1.4		1.3	1.83	2.80		2.95	2.25	2.2	2.1		
6	1.4		1.3	1.90	3.20		2.95	2.00	2.15	2.1		
7	1.4		1.3	1.95	3.60		3.0	1.9	2.1	2.0		
8	1.4		1.3	2.00	3.90		2.9	2.1	2.1	1.95		
9	1.4	1.3	1.75	2.03	4.10		3.1	2.2	2.0	1.95		
10	1.4	1.3	1.75	2.05	4.10		2.6	2.25	1.9	1.9		
11	1.4	1.3	1.75	2.08	4.20		2.4	2.35	1.95	1.95		
12	1.3	1.3	1.75	2.10	4.20		2.95	2.3	1.95	2.05		
13	1.3	1.3	1.75	2.10	4.20		2.6	2.35	1.9	2.1		
14	1.3	1.3	1.75	2.50	4.80		3.0	2.4	1.85	2.15		
15	1.3	1.3	1.75	2.50	5.10	4.4	2.95	2.35	1.9	2.1		
16	1.3	1.3	1.75	2.70	5.10		3.3	2.15	1.95	2.05		
17	1.3	1.3	1.75	3.10	4.30	3.9	3.0	2.2	1.95	2.0		
18	1.3	1.3	1.75	4.20	3.80	3.85	2.9	2.15	2.0			
19	1.3	1.3	1.75	4.20	3.80	3.7	2.9	2.15	1.95			
20	1.3	1.3	1.75	4.40	3.80	3.6	2.95	2.1	1.9			
21	1.3	1.3	1.75	4.50	3.70	3.5	2.75	2.2	1.85			
22	1.3	1.3	1.75	4.30	3.70	3.45	2.78	2.25	1.9			
23	1.3	1.3	1.75	3.80	3.70	3.4	2.75	2.3	1.95			
24	1.3	1.3	1.75	3.80	3.70	3.4	2.65	2.3	1.95			
25	1.3	1.3	1.75	3.80	3.70	3.75	2.65	2.25	1.9			
26	1.3	1.3	1.75	3.50	3.90	3.3	2.6	2.2	1.95			
27		1.3	1.75	3.50	3.80	3.3	2.5	2.0	2.00			
28		1.3	1.75	3.30	3.75	3.3	2.45	2.0	2.00			
29		1.3	1.75	3.20	3.90	3.1	2.4	2.1	1.95			
30			1.75	2.80	4.70	3.0	2.5	2.15	2.0			
31			1.75		5.30		2.45	2.15				

NOTE.—Gage washed out June 5, 1908. It was replaced June 15.

Rating tables for Two Medicine River at Family, Mont.

APRIL 26 TO JUNE 2, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	420	3.60	905	4.30	1,530	5.00	2,300
3.00	475	3.70	990	4.40	1,630	5.10	2,420
3.10	535	3.80	1,075	4.50	1,730	5.20	2,540
3.20	600	3.90	1,160	4.60	1,840	5.30	2,670
3.30	670	4.00	1,250	4.70	1,950	5.40	2,800
3.40	745	4.10	1,340	4.80	2,060	5.50	2,930
3.50	825	4.20	1,430	4.90	2,180	5.60	3,060

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the subsequent curve. It is fairly well defined.

Rating tables for Two Medicine River at Family, Mont.—Continued.

JUNE 3, 1907, TO JUNE 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	17	2.50	370	3.70	1,230	5.80	3,500
1.40	25	2.60	425	3.80	1,320	6.00	3,760
1.50	35	2.70	485	3.90	1,410	6.20	4,030
1.60	50	2.80	545	4.00	1,500	6.40	4,310
1.70	70	2.90	610	4.20	1,690	6.60	4,590
1.80	95	3.00	680	4.40	1,890	6.80	4,870
1.90	120	3.10	750	4.60	2,090	7.00	5,150
2.00	150	3.20	825	4.80	2,310	8.00	6,800
2.10	185	3.30	900	5.00	2,530	8.40	7,550
2.20	225	3.40	980	5.20	2,760		
2.30	270	3.50	1,060	5.40	3,000		
2.40	320	3.60	1,140	5.60	3,240		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period, and is well defined between gage heights 2.0 feet and 5.0 feet.

JUNE 17 TO OCTOBER 17, 1908.

1.80	58	2.50	283	3.20	695	3.90	1,280
1.90	79	2.60	331	3.30	770	4.00	1,380
2.00	103	2.70	383	3.40	850	4.10	1,480
2.10	131	2.80	438	3.50	930	4.20	1,580
2.20	163	2.90	497	3.60	1,015	4.30	1,680
2.30	199	3.00	560	3.70	1,100	4.40	1,790
2.40	239	3.10	625	3.80	1,190		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and the form of the previous curve, and is fairly well defined below gage height 3.0 feet.

Monthly discharge of Two Medicine River near Family, Mont., for 1907 and 1908.

[Drainage area, 368 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 26–30	505	420	478	1.30	0.24	4,740	A.
May	2,930	475	1,500	4.08	4.70	92,200	A.
June	7,550	1,640	2,650	7.20	8.03	158,000	A.
July	2,130	455	982	2.67	3.08	60,400	A.
August	425	126	259	.704	.81	15,900	A.
September	320	248	282	.764	.85	16,800	A.
October	225	60	110	.299	.34	6,760	C.
November	60	50	53.0	.144	.16	3,150	D.
December	50	25	40.0	.109	.13	2,460	D.
The period						360,000	
1908.							
January	25		19.8	.054	.06	1,220	D.
February			17.0	.046	.05	978	D.
March	82	17	65.2	.177	.20	4,010	D.
April	1,990	82	704	1.91	2.13	41,900	B.
May	2,880	370	1,420	3.86	4.45	87,300	A.
June, 20 days		560	1,800	4.89	3.64	71,400	B.
July	770	239	449	1.22	1.41	27,600	B
August	283	79	171	.465	.54	10,500	C.
September	163	68	101	.274	.31	6,010	C.
October 1–17	147	79	112	.304	.19	3,780	C.
The period						255,000	

NOTE.—Discharge January 27–February 8, 1908, estimated.

31260—IRR 246—10——6

BADGER CREEK NEAR FAMILY, MONT.

This station, which is located near the road crossing 4 miles east of Family, Mont., was established April 20, 1907, to determine the amount of water available for irrigation. The United States Reclamation Service proposes to divert the natural flow of the stream to irrigate land in the eastern part of the Blackfeet Indian Reservation and north of Birch Creek.

The gage and bench marks were washed out in June, 1908, and a new gage was established July 22, 1908, about 400 feet farther up stream and at a different datum. As the bench mark was destroyed the relation between the two gages could not be determined.

On account of poor channel conditions and absence of high-water measurements, high-water records are only fair. The low records, however, are good.

Discharge measurements of Badger Creek near Family, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 26[a]	Robert Follansbee	53	80	1.35	239
July 23	J. B. Pierson	90	230	1.38	420
August 13	do	90	203	.98	288
September 4	do	90	194	.83	244
1908.					
April 16	A. F. Huch	90	184	.80	212
May 20	do	86	223	1.70	490
July 22[a]	Stewart and Huch	45	72.5	2.43	238
August 19[a]	do	33	41.6	2.10	153
October 1[a]	A. F. Huch	27	39.6	2.01	128

[a] Made by wading.

NOTE.—There was a marked change in the channel caused by high water in 1907.

Daily gage height, in feet, of Badger Creek near Family, Mont., for 1907 and 1908.

[J. T. Hockersmith, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
1		1.30	3.25	2.50	1.15	0.90	0.78		
2		1.35	3.60	2.40	1.10	.88	.78		
3		1.30	3.30	2.40	1.10	.85	.78	0.68	
4		1.35	2.95	2.30	1.10	.85	.78	.68	
5		1.30	2.95	2.20		.85	.78	.65	
6		1.35	3.15	2.10		.85	.78	.65	
7		1.40	3.25	2.00		.85	.78	.65	
8		1.50	3.40	1.90		.85	.75	.68	
9		1.80	3.15	1.90	1.02	.85	.75	.68	
10		2.10	3.00	1.90	1.02	.85	.72	.68	
11		2.50	2.90	1.85	1.00	.88	.72	.68	
12		2.30	2.80	1.75		.88	.72	.68	
13		2.10	2.90	1.70		.88	.72	.68	
14		2.00	2.75	1.65		.90	.72	.68	
15		2.45	2.70	1.60	.92	.88	.72	.65	
16		2.85	2.55	1.60	.90	.88	.70	.65	
17		3.10	2.50	1.55	.90	.88	.70	.65	
18		2.85	2.60	1.50	.90	.85	.70	.65	
19		2.60	2.80	1.50	.90	.85	.70	.62	
20		2.85	2.90	1.45	.90	.82	.70	.62	

Daily gage height, in feet, of Badger Creek near Family, Mont., for 1907 and 1908 — Continued.

Day.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
21	.....	2.80	2.85	1.40	0.88	0.82	0.70	0.60	.....
22	.....	2.80	3.30	1.35	.88	.80	.70	.60	.....
23	.....	2.55	.....	1.30	.90	.80	.70	.62	.....
24	.....	2.50	3.80	1.28	.90	.78	.70	.65	.....
25	.....	2.30	3.30	1.25	.90	.78	.70	.....	.....
26	.....	2.10	3.10	1.22	.90	.78	.70	.....	.....
27	1.35	2.10	3.15	1.20	.90	.78	.70	.....	.....
28	1.10	2.10	3.20	1.20	.95	.78	.68	.....	.....
29	1.25	2.45	3.00	1.30	.90	.78	.....	.....	.....
30	1.30	2.70	2.80	1.25	.85	.78	.....	.....	.....
31	.....	2.80	.....	1.20	.95	.....	.....	.....	.....
1908.									
1	.50	.95	3.90	.....	.....	.....	2.05	2.02	.....
2	.59	1.22	3.50	.....	.....	2.00	2.08	2.02	.....
3	.48	1.35	3.20	.....	.....	2.00	2.10	2.02	2.60
4	.48	1.28	5.90	.....	.....	.....	2.08	2.00	2.80
5	.48	1.42	.....	.....	.....	.....	2.08	2.00	3.00
6	.48	1.60	.....	.....	.....	.....	2.08	2.00	3.25
7	.48	1.90	.....	.....	.....	.....	2.05	2.00	3.50
8	.48	2.10	.....	.....	.....	2.00	2.05	2.00	3.75
9	.45	2.05	.....	.....	.....	2.00	2.05	2.00	3.40
10	.45	1.80	.....	.....	.....	1.95	2.08	2.00	3.40
11	.48	1.82	.....	.....	.....	1.95	2.08	2.00	3.40
12	.60	1.88	.....	.....	.....	1.95	2.10	2.00	3.40
13	.70	1.75	.....	.....	.....	1.95	2.20	2.00	3.40
14	.88	1.88	.....	.....	.....	1.95	2.30	2.00	.....
15	.85	1.95	.....	.....	.....	1.95	2.25	2.00	.....
16	.88	1.88	.....	.....	.....	1.95	2.20	2.00	.....
17	.88	1.75	.....	.....	.....	.....	2.18	2.00	.....
18	.90	1.68	.....	.....	.....	.....	2.15	2.00	.....
19	1.30	1.68	.....	.....	2.10	.....	2.12	2.00	.....
20	1.50	1.60	.....	.....	2.12	.....	2.12	2.00	3.40
21	1.72	1.60	.....	2.45	.....	.....	2.10	2.00	.....
22	1.50	1.60	.....	2.43	.....	.....	2.10	2.00	.....
23	1.70	1.60	.....	.....	.....	.....	2.10	1.98	.....
24	1.60	1.70	.....	.....	.....	.....	2.08	1.98	.....
25	1.40	2.00	.....	.....	.....	2.00	2.08	1.98	.....
26	1.22	2.20	.....	.....	.....	2.00	2.08	1.98	.....
27	1.15	2.00	.....	.....	.....	2.25	2.08	2.00	2.80
28	1.08	2.05	.....	.....	.....	2.25	2.05	2.00	.....
29	1.00	2.10	.....	.....	.....	2.50	2.05	2.00	.....
30	1.00	2.30	.....	.....	.....	2.50	2.05	.....	.....
31	.....	3.00	.....	.....	.....	.....	2.05	.....	.....

NOTE.—Gage washed out June 5, 1908; replaced July 22, 1908. New gage heights are not comparable with the old ones.
Ice conditions during December, 1907 and 1908.

Rating tables for Badger Creek near Family, Mont.

APRIL 26 TO JUNE 23, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	170	1.80	400	2.50	730	3.20	1,133
1.20	195	1.90	440	2.60	783	3.30	1,195
1.30	225	2.00	480	2.70	838	3.40	1,257
1.40	255	2.10	525	2.80	894	3.50	1,320
1.50	290	2.20	575	2.90	951	3.60	1,383
1.60	325	2.30	625	3.00	1,010		
1.70	360	2.40	677	3.10	1,071		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of subsequent curves and is only approximate.

Rating tables for Badger Creek near Family, Mont.—Continued.

JUNE 24 TO NOVEMBER 24, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	190	1.50	464	2.40	876	3.30	1,410
.70	212	1.60	502	2.50	930	3.40	1,475
.80	236	1.70	542	2.60	985	3.50	1,540
.90	264	1.80	584	2.70	1,040	3.60	1,605
1.00	294	1.90	628	2.80	1,100	3.70	1,670
1.10	326	2.00	674	2.90	1,160	3.80	1,740
1.20	358	2.10	722	3.00	1,220		
1.30	392	2.20	772	3.10	1,280		
1.40	428	2.30	824	3.20	1,345		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and is fairly well defined below gage height 1.5 feet. Above gage height 1.5 feet the extension is uncertain.

APRIL 1 TO JUNE 4, 1908.

0.40	133	1.50	410	2.60	935	3.40	2,080
.50	151	1.60	450	2.70	990	3.60	2,220
.60	170	1.70	490	2.80	1,045	4.80	2,360
.70	190	1.80	535	2.90	1,105	5.00	2,500
.80	212	1.90	580	3.00	1,165	5.20	2,660
.90	235	2.00	625	3.20	1,285	5.40	2,820
1.00	259	2.10	675	3.40	1,410	5.60	2,980
1.10	285	2.20	725	3.60	1,540	5.80	3,140
1.20	313	2.30	775	3.80	1,670	6.00	3,300
1.30	343	2.40	825	4.00	1,800		
1.40	375	2.50	880	4.20	1,940		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the general form of the 1907 curve. It is fairly well defined below gage height 2.0 feet. Above 2.0 feet the rating is uncertain.

JULY 21 TO DECEMBER 31, 1908.

1.90	105	2.10	151	2.30	204	2.50	261
2.00	127	2.20	177	2.40	232		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and is well defined. This table refers to the new gage established July 22, 1908.

Monthly discharge of Badger Creek near Family, Mont., for 1907 and 1908.

[Drainage area, 224 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 26–30	240	170	217	0.969	0.18	2,150	C.
May	1,070	225	595	2.66	3.07	36,600	C.
June		730	1,140	5.09	5.68	67,800	C.
July	930	358	543	2.42	2.79	33,400	A.
August	342	250	284	1.27	1.46	17,500	A.
September	264	231	247	1.10	1.23	14,700	B.
October	231	208	218	.973	1.12	13,400	C.
November 1–24	208	190	202	.902	.81	9,620	C.
The period						195,000	
1908.							
April	499	142	251	1.12	1.25	14,900	B.
May	1,160	247	546	2.44	2.81	33,600	B.
September	261		136	.607	.68	8,090	B.
October	204	139	152	.679	.78	9,350	B.
November	132	123	127	.567	.63	7,560	C.

NOTE.—Discharge June 23, 1907, estimated at 2,800 second-feet. Discharge estimated September 1, 4–7, 17–24, and November 30, 1908.

BIRCH CREEK NEAR DUPUYER, MONT.

This station, which is located at Shields ranch, 12 miles northwest of Dupuyer, Mont., and about 25 miles from its junction with Two Medicine River, was established July 25, 1907, to determine the amount of water available for irrigation projects on the Blackfeet Indian Reservation.

No storage is used on this stream, but a number of ditches divert water for irrigation. The largest of these, owned by the Conrad Investment Company, diverts water about one-half mile below the station.

The gage datum remained the same from the time the station was established until the high water of June, 1908, when the gage was washed away and the channel changed. A temporary staff gage was put in July 23, 1908, about 200 feet below the original gage. This gage was used until October 1, 1908, when a permanent chain gage was established one-fourth mile above.

Discharge measurements of Birch Creek near Dupuyer, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 25	Robert Follansbee	73	120	3.20	296
August 14	J. B. Pierson	70	95	2.85	182
September 3	do	65	86	2.71	160
1908.					
April 14	A. F. Huch	65	84.5	2.71	152
May 19	do	70	120.	3.32	381
July 23[a]	Stewart and Huch	35	76.6	2.44	168
August 19[a]	do	30	52.3	2.20	113

[a] Made by wading.

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1907 and 1908.

[R. F. Shields and R. A. Earhart, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1	.....	3.05	2.8	2.6	2.5	2.45	16	.....	2.8	2.7	2.5	2.45	.....
2	.....	3.05	2.75	2.6	2.5	2.45	17	.....	2.8	2.65	2.5	2.45	.....
3	.....	3.05	2.7	2.6	2.5	2.45	18	.....	2.8	2.65	2.5	2.45	.....
4	.....	3.05	2.7	2.6	2.5	2.45	19	.....	2.8	2.65	2.5	2.45	.....
5	.....	3.0	2.7	2.6	2.5	2.45	20	.....	2.8	2.65	2.5	2.45	.....
6	.....	2.95	2.7	2.6	2.5	2.45	21	.....	2.8	2.65	2.5	2.45	.....
7	.....	2.9	2.7	2.6	2.5	2.45	22	.....	2.75	.....	2.5	2.45	.....
8	.....	2.85	2.7	2.6	2.5	2.45	23	.....	2.75	.....	2.5	2.45	.....
9	.....	2.8	2.7	2.55	2.5	2.45	24	.....	2.75	.....	2.5	2.45	.....
10	.....	2.8	2.7	2.55	2.5	2.45	25	.....	2.75	.....	2.5	2.45	.....
11	.....	2.8	2.7	2.55	2.45	2.45	26	3.1	2.75	.....	2.5	2.45	.....
12	.....	2.8	2.7	2.55	2.45	2.45	27	3.1	2.8	.....	2.5	2.45	.....
13	.....	2.8	2.75	2.55	2.45	2.45	28	3.1	2.8	.....	2.5	2.45	.....
14	.....	2.8	2.75	2.5	2.45	2.45	29	3.1	2.8	.....	2.5	2.45	.....
15	.....	2.8	2.7	2.5	2.45	.....	30	3.1	2.8	.....	2.5	2.45	.....
							31	3.05	2.85	.....	.....	.....	.....

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1		2.30	2.80	5.99		2.30	2.15	3.95	4.04	3.87
2		2.25	2.87	6.00		2.32	2.18	4.04	4.05	3.88
3		2.25	2.92	5.13		2.25	2.13	4.03	4.05	3.94
4		2.25	2.87	6.83		2.32	2.10	4.04	4.05	4.35
5		2.25	2.94			2.35	2.20	4.10	4.05	4.05
6		2.25	3.25			2.36	2.12	4.09	4.05	4.04
7		2.25	3.17			2.25	2.20	4.13	4.08	4.17
8		2.25	3.34			2.35	2.10	4.10	4.02	3.98
9		2.25	3.24			2.27	2.15		3.98	3.91
10		2.30	3.26			2.30	2.13	4.11	3.98	3.83
11		2.35	3.32			2.23	2.10	4.10	4.00	4.03
12		2.50	3.38			2.25	2.80	4.10	3.99	4.00
13		2.55	3.32			2.26	2.60	4.11	3.95	3.88
14		2.55	3.42			2.35	2.50	4.18	3.89	4.00
15	2.30	2.60	3.50			2.28	2.50	4.18	3.88	4.83
16	2.30	2.60	3.49			2.28	2.50	4.19	3.87	4.51
17	2.30	2.60	3.42			2.26	2.18	4.15	3.95	4.32
18	2.30	2.70	3.36			2.30	2.17	4.14	3.96	4.10
19	2.30	3.10	3.32			2.20	2.15	4.13	3.95	4.52
20	2.30	3.20	3.30			2.23	2.13	4.11	3.94	4.80
21	2.30	3.30	3.32			2.24	2.70	4.01	3.93	4.88
22	2.30	3.20	3.29			2.28	2.50	4.02	3.93	4.89
23	2.25	3.30	3.28		2.44	2.20	2.80		3.93	
24	2.25	3.25	3.35		2.56	2.28	2.80	4.04	3.94	
25	2.30	3.10	3.27		2.30	2.30		4.08		
26	2.35	2.90	3.46		2.50	2.20		4.05	3.94	
27	2.40	2.90	3.55		2.40	2.20		4.03	4.00	
28	2.50	2.85	3.44		2.60	2.21	2.15	4.04	3.95	
29	2.35	2.80	3.49		2.40	2.18	2.25	4.05	3.89	
30	2.30	2.80	3.64		2.30	2.18	2.23	4.05	3.86	
31	2.30		4.60		2.50	2.20		4.04		

NOTE.—Gage washed out June 5, 1907. Observer away September 22–30, 1907. Ice conditions December 15–31, 1907, and December 23–31, 1908.

Rating tables for Birch Creek near Dupuyer, Mont.

JULY 25, 1907, TO JUNE 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	80	3.10	268	4.00	790	4.90	1,595
2.30	90	3.20	309	4.10	870	5.00	1,690
2.40	102	3.30	355	4.20	955	5.20	1,890
2.50	116	3.40	405	4.30	1,040	5.40	2,090
2.60	133	3.50	460	4.40	1,130	5.60	2,290
2.70	154	3.60	520	4.50	1,220	5.80	2,490
2.80	177	3.70	580	4.60	1,310	6.00	2,690
2.90	204	3.80	645	4.70	1,405		
3.00	233	3.90	715	4.80	1,500		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and is well defined between gage heights 2.5 feet and 3.5 feet. Above 3.5 feet the extension is liable to considerable error.

JULY 23 TO SEPTEMBER 30, 1908.

2.10	95	2.30	133	2.50	182	2.70	244
2.20	113	2.40	156	2.60	211	2.80	281

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during period and the form of the previous curve, and is fairly well defined.

Monthly discharge of Birch Creek, near Dupuyer, Mont., for 1907 and 1908.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
July 25–31	288	250	268	1.73	0.45	3,720	A.
August	250	166	189	1.22	1.41	11,600	B.
September	177		150	.968	1.08	8,930	B.
October	133	116	122	.787	.91	7,500	B.
November	116	109	111	.716	.80	6,600	C.
December 1–14	109	109	109	.703	.37	3,030	C.
1908.							
March 15–31	116	85	92.4	.596	.38	3,120	C.
April	355	85	167	1.08	1.20	9,940	A.
May	1,310	177	390	2.52	2.90	24,000	A.
July 23–31	211	133	169	1.09	.36	3,020	B.
August	147	109	126	.813	.94	7,750	B.
September	281	95	150	.968	1.08	8,930	B.

NOTE.—Discharge June 4, 1908, estimated. Discharge interpolated for missing days in September, 1908.

DUPUYER CREEK AT DUPUYER, MONT.

This station, which is located at the highway bridge at Dupuyer, Mont., was established April 15, 1908, to obtain data for use in connection with irrigation projects in that locality.

The datum of the gage has not been changed since the station was established. Frequent discharge measurements are necessary to insure good results at this station as the channel conditions are poor. Ice affects the results during the winter months.

Discharge measurements of Dupuyer Creek at Dupuyer, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 14	A. F. Huch	38	46.1	1.22	21.9
May 19[a]	do	30	28.9	1.65	65.9
June 16	do	40	54.8	2.37	253
July 22[a]	Stewart and Huch	26	31.1	1.28	53.1
August 19[a]	do	23	27.4	1.08	32.7

[a] Made by wading.

Daily gage height, in feet, of Dupuyer Creek at Dupuyer, Mont., for 1908.

[George A. Little and Hildreath Miller, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.24	2.40	2.10	1.08	0.98	1.05	1.03	2.01
2	.....	1.24	2.02	2.08	1.08	.98	1.02	1.03	2.02
3	.....	1.12	2.32	2.07	1.06	.98	1.03	1.03	2.00
4	.....	1.18	3.02	2.04	1.06	.96	1.03	1.03	2.00
5	.....	1.16	4.80	2.01	1.03	.95	1.03	1.03	2.00
6	.....	1.14	4.70	2.00	.99	.94	1.04	1.03	.....
7	.....	1.14	3.98	1.98	.98	.90	1.03	1.03	.....
8	.....	1.14	3.96	1.98	.96	.88	1.02	1.03	.....
9	.....	1.24	3.91	1.94	.94	.85	1.02	1.04	.....
10	.....	1.37	3.82	1.88	.92	.85	1.02	1.04	.....
11	.....	1.42	3.74	1.86	.88	.85	1.02	1.04	.....
12	.....	1.47	3.64	1.84	.91	.85	1.02	1.04	.....
13	.....	1.52	3.54	1.91	1.46	.82	1.02	1.05	.....
14	.....	1.61	3.24	2.06	1.39	.82	1.02	1.09	.....
15	1.22	1.74	2.76	2.02	1.30	.82	1.02	2.00	.....
16	1.21	1.78	2.36	1.96	1.26	.86	1.02	1.06	.....
17	1.21	1.71	2.32	1.93	1.14	.94	1.03	1.04	.....
18	1.21	1.68	2.30	1.89	1.08	.95	1.02	1.04	.....
19	1.22	1.66	2.29	1.68	1.10	.95	1.02	1.04	.....
20	1.22	1.66	2.28	1.66	1.10	.95	1.02	1.04	.....
21	1.22	1.65	2.27	1.64	1.10	.90	1.02	1.04	.....
22	1.22	1.64	2.24	1.51	1.05	.90	1.02	1.04	.....
23	1.23	1.62	2.20	1.32	1.05	.90	1.02	1.04	.....
24	1.23	1.58	2.20	1.27	1.00	.95	1.04	1.04	.....
25	1.23	1.59	2.18	1.23	1.00	.95	1.04	1.04	.....
26	1.23	1.62	2.16	1.22	1.00	1.00	1.03	1.04	.....
27	1.24	1.87	2.16	1.22	1.00	1.02	1.03	1.05	.....
28	1.24	1.88	2.15	1.10	1.00	1.02	1.03	1.10	.....
29	1.24	1.78	2.14	1.10	1.00	1.03	1.03	1.11	.....
30	1.24	1.80	2.13	1.10	1.00	1.03	1.04	2.00	.....
31	.....	1.99	.....	1.08	.99	.....	1.04	.....	.....

NOTE.—Ice conditions November 15, November 28–December 31.

Rating tables for Dupuyer Creek at Dupuyer, Mont.

APRIL 14 TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	14	2.00	116	2.90	335	3.80	660
1.20	21	2.10	133	3.00	370	3.90	700
1.30	29	2.20	152	3.10	405	4.00	740
1.40	38	2.30	173	3.20	440	4.20	820
1.50	48	2.40	195	3.30	475	4.40	900
1.60	59	2.50	220	3.40	510	4.60	980
1.70	71	2.60	245	3.50	545	4.80	1,060
1.80	85	2.70	275	3.60	580		
1.90	100	2.80	305	3.70	620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the subsequent curve, and is not well defined. Above gage height 2.0 feet this table is only approximate.

JUNE 6 TO NOVEMBER 27, 1908.

0.80	10	1.60	98	2.40	257	3.40	580
0.90	17	1.70	114	2.50	284	3.60	650
1.00	25	1.80	131	2.60	313	3.80	720
1.10	34	1.90	149	2.70	343	4.00	790
1.20	44	2.00	168	2.80	375	4.20	870
1.30	56	2.10	188	2.90	407	4.40	950
1.40	69	2.20	209	3.00	440	4.60	1,030
1.50	83	2.30	232	3.20	510	4.80	1,110

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined below gage height 2.5 feet.

Monthly discharge of Dupuyer Creek at Dupuyer, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 14–30	24	22	23.1	779	C.
May	114	15	54.1	3,330	B.
June	1,070	119	405	24,100	B.
July	188	32	120	7,380	A.
August	77	16	31.5	1,940	B.
September	28	11	19.3	1,150	C.
October	30	27	27.7	1,700	C.
November	33	28	29.1	1,730	C.
The period				42,100	

NOTE.—Discharge estimated for November 15, 28–30.

TETON RIVER NEAR BELLEVIEW, MONT.

Teton River, the most important tributary of Marias River, rises in the Rocky Mountains and flows eastward in a course approximately parallel to that of Sun River, crossing and recrossing the sixth standard parallel north, and emptying into the Marias River about a mile above the point where the latter joins the Missouri.

This station, which is located 1 mile north of Peeble's ranch, 16 miles above Chouteau, Mont., was established November 26, 1904, to obtain data for use in connection with irrigation projects. The nearest post-office is Belleview.

No important tributaries enter the stream near the station. Practically no water is diverted above the station, but the ordinary flow below is appropriated and used for irrigation.

An irrigation project now being constructed under the Carey Act proposes to store the flood water of Teton River in a reservoir located about 5 miles north of the gaging station. The water will be diverted one-half mile above the gage. The capacity of the reservoir is 90,000 acre-feet and can be increased to 210,000 by raising the top of the dam 20 feet. It will serve 120,000 acres of land on the north side of the river.

The first gage was spiked to a post on the left bank about 40 feet above the bend of Kroff's irrigation ditch. March 9, 1905, it was moved by the observer 250 feet upstream to avoid the effect of the dam erected at the head of the ditch below. On May 8, 1905, the gage was referred to the bench marks, and it was found that the datum had been raised 0.78 foot in moving, while the difference between the level of the water surface at the old and new locations was but 0.10 foot. The gage datum was lowered on this date 0.20 foot. May 8, 1906, the gage was again moved 1½ miles up stream to Mr. Bjornstad's new ranch and set at an entirely different datum. The station was discontinued during 1907, but was reestablished

again June 16, 1908, near the location of the gage that was used during 1906, but there is no connection between the gage reading.

The current is swift at the gage and the river never freezes entirely across.. The conditions for obtaining accurate discharge data during high water are rather poor on account of the shifting channel.

Discharge measurements of Teton River near Belleview, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 16[a]	J. E. Stewart	65	146	6.98	841
July 8[b]	Raymond Richards	33	77.1	5.55	297
August 31[b]	do	40	52.1	4.84	113
October 14[b]	do	42	49.5	4.81	89

[a] Made from cable. [b] Made by wading.

Daily gage height, in feet, of Teton River near Belleview, Mont., for 1908.

[Belle Peebles, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.9	5.65	5.0	4.8	4.7	4.7	4.6	16	7.1	5.55	4.9	4.7	4.8	4.7	4.6
2	7.0	5.7	5.0	4.8	4.8	4.8	4.6	17	6.95	5.5	4.9	4.7	4.8	4.7	4.6
3	7.1	5.65	5.0	4.8	4.8	4.8	4.6	18	6.9	5.4	4.9	4.8	4.8	4.7	4.5
4	7.35	5.65	5.0	4.8	4.8	4.8	4.6	19	6.75	5.35	4.9	4.8	4.8	4.7	4.5
5	7.7	5.6	5.0	4.7	4.8	4.8	4.6	20	6.55	5.3	4.9	4.7	4.8	4.7	4.5
6	8.75	5.6	5.0	4.7	4.8	4.8	4.6	21	6.35	5.3	4.9	4.7	4.7	4.7	4.5
7	8.3	5.6	5.0	4.7	4.8	4.8	4.6	22	6.3	5.2	4.9	4.7	4.7	4.7	4.5
8	8.55	5.5	5.0	4.7	4.7	4.8	4.6	23	6.25	5.2	4.9	4.7	4.7	4.7	4.5
9	8.75	5.5	4.9	4.7	4.7	4.8	4.7	24	6.2	5.2	4.9	4.7	4.7	4.7	4.5
10	8.95	5.5	4.9	4.7	4.8	4.8	4.7	25	6.1	5.2	4.8	4.7	4.7	4.6	4.5
11	8.8	5.5	4.9	4.7	4.8	4.7	4.7	26	6.0	5.1	4.8	4.7	4.7	4.6	4.5
12	8.2	5.5	4.9	4.7	4.8	4.7	4.7	27	5.75	5.1	4.8	4.7	4.7	4.6	4.4
13	7.9	5.5	4.9	4.7	4.8	4.7	4.6	28	5.85	5.1	4.8	4.7	4.7	4.6	4.4
14	7.55	5.5	4.9	4.7	4.8	4.7	4.6	29	5.7	5.1	4.8	4.7	4.7	4.6	4.5
15	7.35	5.6	4.9	4.7	4.8	4.7	4.6	30	5.7	5.1	4.8	4.7	4.7	4.6	4.5
								31	.....	5.1	4.8	.....	4.7	.....	4.6

Rating table for Teton River near Belleview, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.40	33	5.40	251	6.40	604	7.80	1,186
4.50	46	5.50	281	6.50	645	8.00	1,270
4.60	60	5.60	312	6.60	686	8.20	1,356
4.70	76	5.70	345	6.70	727	8.40	1,442
4.80	95	5.80	379	6.80	768	7.60	1,528
4.90	117	5.90	414	6.90	809	8.80	1,614
5.00	141	6.00	450	7.00	850	9.00	1,700
5.10	167	6.10	487	7.20	934		
5.20	194	6.20	525	7.40	1,018		
5.30	222	6.30	564	7.60	1,102		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and is fairly well defined between gage heights 4.6 feet and 7.5 feet.

Monthly discharge of Teton River near Belleview, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	1,680	345	909	54,100	A.
July	345	167	253	15,600	A.
August	141	95	118	7,260	B.
September	95	76	79.8	4,750	B.
October	95	76	86.4	5,310	B.
November	95	60	78.5	4,670	B.
December	76	33	55.4	3,410	C.
The period				95,100	

MUSSELSHELL RIVER DRAINAGE BASIN.

DESCRIPTION.

Musselshell River is formed by two forks. The North Fork (or master stream) rises on the southern slopes of the Little Belt Mountains in the northern part of Meagher County, Mont., at an elevation of 8,000 feet above sea level, flows southeastward for 10 miles, emerging into an irrigable valley, one-half mile to 1 mile in width, and joining the South Fork near the town of Martinsdale, 30 miles below its source, at an elevation of 4,700 feet above sea level. The South Fork has its source in several small streams draining the northward slopes of Crazy Mountains, about 20 miles southwest of Martinsdale at an elevation of 5,500 feet above sea level, and flows northeastward through a valley 1 mile to 3 miles wide. From Martinsdale the Musselshell flows almost due east for 130 miles to Melstone, where it turns abruptly to the north, and 60 miles farther on it enters the Missouri.

Below the forks the valley widens and is bordered by low rolling hills. The larger part of the basin is covered by glacial deposits. The soil is black loam, and when properly irrigated the land is suitable for agriculture. Forestation is scant. At the headwaters of the North Fork pines are found, but elsewhere the timber consists only of the few cottonwoods and willows that border the stream channels. The mean annual rainfall is about 25 inches in the upper areas of the basin, but near the mouth of the river it decreases to 12 inches.

The principal source of supply for the streams in this basin is the melting snow. Ice forms on the streams during the winter months.

The tributaries of the Musselshell are small intermittent streams and the river exhibits wide variations in discharge. Much of the water is used for irrigation, the diversions all being small. During the irrigating season the Musselshell carries but little water.

A project now under way under the Carey Land Act will utilize a small but excellent reservoir site on the North Fork to store the flood waters of that stream and of Checkerboard Creek which will be

diverted into the reservoir. The dam will be 130 feet high and the reservoir will store 28,000 acre-feet of water. The dam site is 19½ miles from Martinsdale.

The Musselshell basin affords no opportunities for power development. The fall of greatest magnitude occurs on the Upper North Fork, but the supply of water is insufficient to warrant an expenditure necessary to develop it.

The longest records of stream flow in the Musselshell basin have been kept at Shawmut and Harlowton. The wettest year recorded was 1908, while the driest was 1906.

The following gaging stations have been maintained in this drainage basin:

North Fork of Musselshell River near Martinsdale, Mont., 1907–8.
Musselshell River at Harlowton, Mont., 1907–8.
Musselshell River at Shawmut, Mont., 1902–1907.
Musselshell River at Lavina, Mont., 1906.
South Fork of Musselshell River near Martinsdale, Mont., 1907–8.
American Fork near Harlowton, Mont., 1907–8.
Lebo Creek near Harlowton, Mont., 1907–8.

NORTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established July 10, 1907, to determine the amount of water available for irrigation, is located at the ranch of Martin J. Settle, 4 miles north of Martinsdale and one-half mile above the junction of the North and South forks.

All the tributaries to the North Fork enter the stream above the station, the principal ones being Checkerboard and Flagstaff creeks.

Under a Carey Land Act project the water of this fork, which is practically all appropriated, will be stored about 20 miles above the station and used to irrigate land between Martinsdale and Harlowton.

The bed of the stream is composed of gravel and may shift somewhat during high water, as the current is swift. Ice forms during the winter season, but records obtained during the open season are very good.

Discharge measurements of North Fork of Musselshell River near Martinsdale, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	J. E. Stewart	23	38.0	.....	109
July 10	Robert Follansbee	27	52.0	4.48	210
July 26	J. E. Stewart	23	34.8	3.90	104
September 6	do	23	24.4	3.42	433
October 29[a]	do	20	21.0	3.30	28.9
1908.					
April 28	Raymond Richards	23	20.1	3.27	29.6
June 5	do	29	91.5	5.88	436
June 24	J. E. Stewart	24	32.5	3.85	95.7
July 28[a]	Raymond Richards	20	9.4	3.00	7.4
September 24[a]	do	27	15.6	3.21	19.2

[a] Made by wading.

Daily gage height, in feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

[Martin J. Settle, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1	.....	3.6	3.4	3.45	3.35	3.35	16	4.25	3.5	3.4	3.25	.....	4.9
2	.....	3.7	3.4	3.4	3.3	3.35	17	4.0	3.5	3.4	3.35	3.4	.....
3	.....	3.65	3.3	3.4	3.3	3.35	18	3.9	3.45	3.4	3.35	3.4	.....
4	.....	3.6	3.4	3.3	3.3	3.4	19	4.0	3.45	3.3	3.35	3.4	.....
5	.....	3.6	3.4	3.4	3.35	3.4	20	4.1	3.45	3.4	3.25	3.4	.....
6	.....	3.6	3.4	3.4	3.35	3.7	21	4.55	3.5	3.4	3.35	3.35	.....
7	.....	3.55	3.4	3.4	3.35	3.5	22	4.2	3.5	3.3	3.35	3.45	.....
8	.....	3.55	3.4	3.3	3.35	3.3	23	4.0	3.4	3.3	3.35	3.5	.....
9	.....	3.55	3.4	3.4	3.35	3.65	24	3.9	3.45	3.3	3.25	3.5	.....
10	4.5	3.7	3.4	3.4	3.35	3.6	25	3.85	3.35	3.3	3.35	3.5	.....
11	4.1	3.75	3.4	3.4	3.45	3.5	26	3.85	3.35	3.4	3.35	3.35	.....
12	4.0	3.55	3.45	3.3	3.45	3.8	27	3.9	3.35	3.3	3.35	3.5	.....
13	4.0	3.5	3.45	3.4	3.45	3.8	28	3.8	3.45	3.4	3.3	3.5	.....
14	5.0	3.6	3.4	3.4	.....	4.7	29	3.8	3.4	3.4	3.35	3.4	.....
15	4.25	3.5	3.3	3.35	.....	4.7	30	3.8	3.4	3.4	3.35	3.35	.....
							31	3.75	3.4	.....	.....	.....	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	.....	3.2	6.2	3.45	3.05	3.2	3.25	3.45
2	.....	3.2	6.0	3.4	3.05	3.2	3.25	3.45
3	.....	3.2	5.95	3.35	3.05	3.2	3.3	3.45
4	.....	3.1	6.1	3.3	3.0	3.2	3.35	3.45
5	3.25	3.1	5.9	3.3	3.0	3.05	3.4	3.45
6	3.25	3.1	6.25	3.3	3.0	3.2	3.45	3.45
7	3.25	3.05	6.1	3.25	2.95	3.05	3.4	3.45
8	3.25	3.0	5.8	3.2	2.9	3.05	3.4	3.45
9	3.25	3.0	5.5	3.15	2.85	3.05	3.35	3.45
10	3.5	3.0	5.2	3.1	2.85	3.05	3.35	4.0
11	3.6	3.0	5.0	3.1	2.85	3.05	3.35	4.2
12	3.6	3.0	4.75	3.1	2.85	3.05	3.45	4.25
13	3.45	3.0	4.5	3.1	3.1	3.05	3.4	4.3
14	3.4	3.0	4.35	3.1	3.4	3.2	3.4	4.3
15	3.4	3.0	4.25	3.1	3.25	3.2	3.45	4.0
16	3.4	3.0	4.2	3.1	3.25	3.05	3.45	3.5
17	3.4	3.0	4.2	3.1	3.25	3.2	3.45	3.45
18	3.3	3.0	4.15	3.1	3.25	3.2	3.45	3.6
19	3.3	2.95	4.1	3.1	3.25	3.2	3.45	3.5
20	3.3	3.0	4.05	3.1	3.25	3.2	3.45	3.45
21	3.3	3.0	4.0	3.1	3.35	3.2	3.45	3.45
22	3.3	3.0	3.95	3.1	3.35	3.2	3.45	3.45
23	3.3	3.1	3.85	3.1	3.25	3.2	3.45	3.45
24	3.25	3.05	3.8	3.05	3.2	3.25	3.45	3.4
25	3.25	3.1	3.75	3.0	3.2	3.4	3.45	3.45
26	3.25	3.15	3.7	3.0	3.15	3.3	3.45	4.15
27	3.25	3.7	3.6	3.0	3.15	3.3	3.45	4.8
28	3.25	3.5	3.6	3.0	3.15	3.3	3.45	4.0
29	3.3	3.95	3.5	3.0	3.2	3.3	3.45	4.8
30	3.2	3.85	3.45	3.0	3.2	3.25	3.45	4.8
31	.....	5.65	.....	3.0	3.2	.....	3.45	.....

NOTE.—Ice conditions during December, 1907, and November 10–December 31, 1908.

Rating table for North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.85	3	3.70	76	4.50	200	5.30	346
2.90	4	3.80	90	4.60	217	5.40	365
3.00	7	3.90	105	4.70	235	5.50	384
3.10	12	4.00	120	4.80	253	5.60	403
3.20	19	4.10	135	4.90	271	5.70	422
3.30	28	4.20	151	5.00	289	5.80	441
3.40	39	4.30	167	5.10	308	5.90	460
3.50	51	4.40	183	5.20	327	6.00	479
3.60	63						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907–8 and is well defined below gage height 4.0 feet and fairly well defined between gage heights 4.0 feet and 6.0 feet.

Monthly discharge of North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
July 10–31	289	83	132	5,760	A.
August	83	34	52.6	3,230	A.
September	44	28	36.4	2,170	A.
October	44	24	34.2	2,100	A.
November	51	28	39.1	2,330	A.
1908.					
April 5–30	63	19	32.0	1,650	B.
May	412	5.5	32.4	1,990	B.
June	529	44	239	14,200	A.
July	44	7	15.7	965	C.
August	39	3	16.2	996	C.
September	39	10	18.5	1,100	C.
October	44	24	40.1	2,470	B.
November 1–9	44	44	44.0	785	B.
The period				24,200	

MUSSELSHELL RIVER AT HARLOWTON, MONT.

This station, which was established July 11, 1907, to take the place of the station formerly maintained at Shawmut, is located at the highway bridge 1 mile south of Harlowton. The records furnish information of value for irrigation development.

The tributaries above and below the station are all small streams. American Fork enters the stream between this station and Shawmut.

A large part of the valley is irrigated and many small ditches also receive their water supply from the Musselshell. Practically the entire flow of the stream is appropriated. A minimum discharge of 2 second-feet is recorded during the irrigating season at this station.

The gage datum has remained unchanged. The bed of the stream is composed of sand and gravel and may shift. Records obtained during the open season are fair.

During the high water of June, 1908, the approaches to the bridge were partly destroyed, but the gage was not disturbed. In October, 1908, the bridge caved in, destroying the gage.

Discharge measurements of Musselshell River at Harlowton, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12	Robert Follansbee	99	179	1.77	475
July 28	J. E. Stewart	92	137	1.38	275
September 6	do	90	122	1.20	116
October 31	do	89	112	1.07	118
1908.					
April 29	Raymond Richards	87	101	.86	122
June 23	J. E. Stewart	90	274	1.95	554
July 28[a]	Raymond Richards	14	8.6	.04	11
September 25[a]	do	25	14.2	.40	26.8

[a] Made by wading.

Daily gage height, in feet, of Musselshell River at Harlowton, Mont., for 1907 and 1908.

[H. C. Hopkins and Frank A. Smith, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1907.						1907.					
1		1.38	1.30	1.10	1.00	16	2.00	1.25	1.25	1.12	1.00
2		1.30	1.25	1.15	1.00	17	1.85	1.20	1.20	1.10	1.00
3		1.30	1.25	1.15	1.00	18	1.75	1.12	1.20	1.10	1.00
4		1.50	1.20	1.15	1.05	19	1.70	1.10	1.18	1.10	1.02
5		1.45	1.20	1.15	1.05	20	1.70	1.15	1.15	1.10	1.05
6		1.38	1.20	1.15	1.00	21	2.40	1.10	1.15	1.10	1.05
7		1.30	1.20	1.15	1.00	22	2.15	1.12	1.15	1.08	1.05
8		1.25	1.20	1.15	1.00	23	1.95	1.15	1.15	1.05	1.05
9		1.20	1.20	1.15	1.00	24	1.75	1.18	1.10	1.05	1.00
10		2.25	1.20	1.15	1.00	25	1.55	1.20	1.10	1.05	1.00
11	1.90	1.80	1.20	1.15	1.00	26	1.48	1.18	1.10	1.02	1.00
12	1.75	1.48	1.20	1.15	1.00	27	1.42	1.15	1.10	1.00	1.00
13	1.62	1.38	1.25	1.15	.95	28	1.40	1.15	1.10	1.00	1.00
14	1.60	1.30	1.30	1.15	.95	29	1.35	1.20	1.10	1.00	1.00
15	2.10	1.30	1.25	1.15	.98	30	2.05	1.25	1.10	1.00	1.00
						31	1.65	1.25	.....	1.00	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1908.							1908.						
1	.....	0.75	.....	.....	−0.13	0.27	16	.....	1.00	2.55	.....	−0.13	−0.03
2	.....	.80	.....	.....	− .13	.27	17	.....	1.05	2.55	.....	− .03	− .03
3	.....	.75	.....	.....	− .13	.22	18	.....	1.05	2.45	.....	− .03	.17
4	.....	.70	.....	.....	− .13	.07	19	.....	1.05	2.35	.....	− .02	.17
5	.....	.90	3.55	.....	− .17	.07	20	.....	1.05	2.15	.....	− .02	.17
6	.....	.95	3.60	.....	− .18	.07	21	.....	.95	.....	.....	− .03	.37
7	.....	.75	3.55	.....	− .20	.07	22	.....	.95	.....	.....	.07	.37
8	.....	.85	3.35	.....	− .21	.07	23	.....	.90	1.95	.....	.07	.37
9	.....	.85	3.35	.....	− .23	.07	24	.....	.90	.....	.....	.07	.47
10	.....	.90	3.25	.....	− .23	.07	25	.....	1.75	.....	.....	.12	.42
11	.....	.95	3.25	.....	− .23	.07	26	.....	3.85	.....	.....	.12	.42
12	.....	1.00	3.15	.....	− .22	.07	27	.....	4.50	.....	.....	.07	.42
13	.....	1.05	3.15	.....	− .13	.07	28	.....	4.55	.....	0.04	.07	.47
14	.....	1.00	2.85	.....	− .13	.02	29	0.85	4.75	.....	− .01	.23	.47
15	.....	1.00	2.60	.....	− .13	.02	30	.85	4.85	.....	− .03	.27	.42
							31	.....	4.85	.....	− .08	.....	.....

NOTE.—Ice conditions during December, 1907. From June 1–4, 1908, the river was so high that the observer could not reach the gage.

Rating tables for Musselshell River at Harlowton, Mont.

JULY TO AUGUST 10, 1907, AND APRIL 29 TO SEPTEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.25	0	0.80	112	1.90	530	3.00	1,330
− .20	1	.90	135	2.00	590	3.20	1,490
− .10	2	1.00	160	2.10	655	3.40	1,655
.00	5	1.10	188	2.20	725	3.60	1,825
.10	10	1.20	219	2.30	795	3.80	2,000
.20	17	1.30	253	2.40	865	4.00	2,180
.30	27	1.40	290	2.50	940	4.20	2,360
.40	40	1.50	330	2.60	1,015	4.40	2,540
.50	55	1.60	374	2.70	1,090	4.60	2,720
.60	72	1.70	422	2.80	1,170	4.80	2,900
.70	91	1.80	474	2.90	1,250	5.00	3,080

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made 1907–8, and is well defined between gage heights 0 foot and 2.0 feet. Above gage height 2.0 feet the curve is only approximate.

AUGUST 11, 1907, TO NOVEMBER 30, 1907.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., August 11 to November 30, 1907.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		190	108	105	16	227	140	125	105
2		165	110	105	17	210	123	125	105
3		155	115	105	18	195	123	125	105
4		140	120	118	19	180	115	125	110
5		130	120	118	20	190	110	125	118
6		120	125	105	21	170	110	125	118
7		120	125	105	22	185	110	120	118
8		120	125	105	23	190	110	115	118
9		120	125	105	24	190	108	115	105
10		122	125	105	25	195	108	115	105
11	480	122	125	105	26	185	108	108	105
12	315	122	125	105	27	170	108	108	105
13	280	135	125	95	28	170	108	105	105
14	245	145	125	95	29	180	108	105	105
15	240	140	125	100	30	185	108	105	105
					31	185		105	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Musselshell River at Harlowton, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
July 11–31	865	272	471	19,600	A.
August	760	170	250	15,400	C.
September	190	108	125	7,440	C.
October	125	105	119	7,320	C.
November	118	95	107	6,370	C.
1908.					
May	2,940	91	643	39,500	A.
June 5–23	1,820	560	1,210	45,600	B.
August	24	.4	5.56	342	D.
September	50	4.1	21.6	1,290	D.

MUSSELSHELL RIVER AT SHAWMUT, MONT.

This station, which was established August 12, 1902, to determine the amount of water available for irrigation and storage, was located at the ranch of the Bloomington Land and Cattle Company, one-eighth mile from the post-office of Shawmut and 25 miles east of Harlowton.

The station was maintained for several years, but the continuity of the records was frequently interrupted because of the difficulty of obtaining an observer. For this reason, and because of the heavy expense incidental to a station so inaccessible, it was abandoned on June 30, 1907, and a new station was established.

Many small and intermittent streams enter above and below the station. American Fork, which comes in 15 miles above, is one of the more important of these tributaries.

Irrigation is extensively developed along the Musselshell, and many diversions are made both above and below the station. The water is practically all appropriated.

On April 22, 1905, a new gage was established on the right bank 400 feet below the old gage, with a datum 0.29 foot greater. Thereafter until the station was discontinued the gage datum remained unchanged.

Records obtained during the open season were fair.

Discharge measurements of Musselshell River at Shawmut, Mont., in 1907.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
April 26	J. E. Stewart	96	3.31	273
June 18	do	225	3.54	560

NOTE.—The above measurements were made at different sections.

Daily gage height, in feet, of Musselshell River at Shawmut, Mont., for 1907.

[G. T. Gorner, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	Day.	Feb.	Mar.	Apr.	May.	June.
1	.....	.....	.....	3.1	4.0	16	.....	2.7	.....	3.5	4.1
2	.....	.....	.....	3.2	4.3	17	.....	.....	.....	3.7	4.0
3	.....	3.1	.....	3.2	4.8	18	.....	.....	.....	3.8	3.5
4	.....	3.0	.....	3.3	4.7	19	.....	.....	.....	4.5	3.3
5	3.4	2.9	.....	3.2	4.5	20	.....	.....	.....	4.8	3.4
6	3.6	2.85	.....	3.2	4.4	21	.....	.....	.....	5.3	4.8
7	3.8	2.8	.....	3.2	4.5	22	.....	.....	.....	5.7	4.5
8	3.9	2.7	.....	3.2	4.6	23	.....	.....	.....	5.4	.....
9	3.95	2.65	.....	3.3	4.4	24	.....	.....	.....	4.9	.....
10	4.0	3.0	.....	3.3	4.5	25	.....	.....	3.3	4.8	.....
11	4.1	2.9	.....	3.4	4.4	26	.....	.....	3.3	4.3	.....
12	.....	2.8	.....	3.5	4.4	27	.....	.....	3.2	4.0	.....
13	.....	2.7	.....	3.8	4.2	28	.....	.....	3.3	4.0	5.6
14	.....	2.6	.....	3.6	4.3	29	.....	.....	3.3	3.8	5.5
15	.....	2.65	.....	3.6	4.5	30	.....	.....	3.1	4.2	5.1
						31	.....	.....	.....	4.2	.....

NOTE.—Water above gage June 23–27.

SOUTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established June 19, 1907, to determine the amount of water available for irrigation, was located near the ranch of Martin J. Settle, but on April 28, 1908, it was removed upstream about 1½ miles, near the blacksmith shop of the Martinsdale Sheep Company and near the public highway 1¼ miles northeast of Martinsdale.

The South Fork has no important tributaries. Many small ditches are taken from the creek, and during the irrigating season all the water is diverted.

When the new station was established a new datum was used, which has remained unchanged. The bed of the stream is chiefly gravel and is clean and nonshifting. Ice forms during the winter season, but records obtained during the open season are good.

Discharge measurements of South Fork of Musselshell River near Martinsdale, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	J. E. Stewart	40	125	[a] 2.38	243
July 11	Robert Follansbee	40	108	2.05	187
July 26 [b]	J. E. Stewart	25	33.0	1.62	101
September 6 [b]	do	26	18.2	1.18	31.4
October 29 [b]	do	16	19.7	1.13	30.5
1908.					
April 28	Raymond Richards	39	70.4	1.99	65.0
June 24	J. E. Stewart	39	122	3.28	226
July 28 [b]	Raymond Richards	16	7.4	1.08	11.2
September 24 [b]	do	5	1.3	.67	.6

[a] Gage height somewhat uncertain. [b] Wading near gage.

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

[Martin J. Settle and J. G. Wallace, observers.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.							1907.						
1		2.7	1.6	1.25	1.25	1.15	16		2.1	1.3	1.2	1.1	1.05
2		2.5	1.6	1.25	1.2	1.15	17		2.0	1.2	1.2	1.1	1.1
3		2.3	1.9	1.2	1.3	1.15	18		1.9	1.2	1.2	1.2	1.1
4		2.3	1.6	1.2	1.2	1.15	19	1.9	1.9	1.2	1.2	1.1	1.1
5		2.3	1.5	1.2	1.2	1.15	20	2.1	2.0	1.0	1.2	1.1	1.1
6		2.1	1.5	1.2	1.3	1.15	21	2.1	2.0	1.1	.9	1.2	1.1
7		2.0	1.5	1.2	1.2	1.15	22	2.3	2.1	1.05	1.1	1.1	1.1
8		2.0	1.5	1.2	1.2	1.15	23		2.0	1.05	1.0	1.1	1.1
9			1.4	1.2	1.3	1.15	24		1.9	1.1	1.0	1.2	
10		2.15	1.7	1.2	1.2	1.15	25		1.75	1.1	1.0	1.1	
11		2.0	1.7	1.2	1.2	1.1	26	3.6	1.6	1.1	1.0	1.1	
12		1.9	1.5	1.25	1.3	1.05	27	3.4	1.55	1.1	1.2	1.2	
13		1.9	1.45	1.25	1.2	1.05	28	3.1	1.55	1.2	1.2	1.1	
14		2.0	1.4	1.2	1.2	1.05	29	2.9	1.55	1.15	1.2	1.1	
15		2.1	1.3	1.2	1.2	1.05	30	2.8	1.8	1.15	1.2	1.1	
							31		1.6	1.25			

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	.....	1.85	5.7	2.7	0.8	1.5	1.5	1.9
2	.....	1.85	5.7	2.5	.7	.9	1.6	1.9
3	.....	1.9	5.6	2.4	.7	.9	1.7	1.9
4	.....	1.9	5.8	2.45	.7	.9	1.8	1.9
5	1.05	1.95	5.65	2.3	.7	.8	1.7	1.85
6	1.05	1.95	5.6	2.3	.6	.7	1.7	1.85
7	1.05	2.0	5.8	2.2	.6	.75	1.5	1.85
8	1.05	2.0	5.5	2.0	.5	.75	1.5	1.85
9	1.05	2.5	5.6	1.9	.6	.6	1.7	1.85
10	1.2	2.85	5.5	1.7	.7	.6	1.7	.....
11	1.2	2.85	5.3	1.4	.5	.65	1.6	.....
12	1.3	2.8	5.2	1.35	.4	.6	1.5	.....
13	1.2	2.75	5.0	1.3	.5	.5	1.5	.....
14	1.2	2.65	4.8	1.2	.5	.55	1.45	.....
15	1.2	2.75	4.6	.8	.5	.55	1.6	.....
16	1.3	2.8	4.5	.7	.9	.65	1.7	.....
17	1.4	2.8	4.4	.7	.9	.65	1.9	1.85
18	1.5	2.75	4.4	.7	.9	.7	1.8	1.9
19	1.55	2.65	4.5	.7	1.1	.7	1.75	1.8
20	1.6	2.6	4.0	.7	1.0	.7	1.8	1.85
21	1.6	2.6	3.8	.7	1.0	.75	1.7	1.85
22	1.7	2.5	3.7	.7	1.2	.55	1.65	1.5
23	1.9	2.5	3.5	.8	1.1	.65	1.65	1.5
24	1.9	2.55	3.4	.8	1.0	.65	1.8	1.55
25	1.8	2.6	3.2	1.0	.9	.7	1.8	1.55
26	1.6	2.8	3.2	1.15	.9	.7	1.8	.....
27	1.6	3.75	3.5	1.15	.9	.75	1.8	.....
28	2.0	4.15	3.0	1.15	.8	.75	1.85	.....
29	1.95	4.4	2.85	1.0	1.0	1.0	1.85	.....
30	1.95	4.4	2.75	.9	1.0	2.0	1.9	.....
31	.....	5.35	.....	.9	1.0	.....	1.8	.....

NOTE.—Observer unable to get to gage June 23–25, 1907, because of high water. New gage installed April 28, 1908. New gage heights not comparable with old. Ice conditions latter part of November–December 31, 1907, and November 10–December 31, 1908.

Rating tables for South Fork of Musselshell River near Martinsdale, Mont.

JUNE 19, 1907, TO APRIL 27, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	7	1.60	96	2.30	229	3.00	381
1.00	15	1.70	113	2.40	250	3.10	404
1.10	26	1.80	131	2.50	271	3.20	428
1.20	38	1.90	150	2.60	292	3.30	452
1.30	51	2.00	169	2.70	314	3.40	477
1.40	65	2.10	189	2.80	336	3.50	502
1.50	80	2.20	209	2.90	358	3.60	527

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1907, and is well defined between gage heights 1.0 foot and 2.5 feet.

APRIL 28 TO NOVEMBER 10, 1908.

0.50	0	1.70	43	2.90	170	4.20	389
.60	0.5	1.80	50	3.00	184	4.40	429
.70	1	1.90	58	3.10	199	4.60	472
.80	3	2.00	66	3.20	214	4.80	517
.90	5	2.10	75	3.30	230	5.00	564
1.00	8	2.20	85	3.40	246	5.20	613
1.10	11	2.30	95	3.50	263	5.40	664
1.20	15	2.40	106	3.60	280	5.60	716
1.30	19	2.50	118	3.70	297	5.80	768
1.40	24	2.60	130	3.80	315		
1.50	30	2.70	143	3.90	333		
1.60	36	2.80	156	4.00	351		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908, and is well defined between gage heights 0.5 foot and 3.5 feet.

Monthly discharge of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
June (9 days)	527	150	318	5,680	A.
July	314	88	168	10,000	A.
August	150	15	58.5	3,600	B.
September	44	7	34.3	2,040	B.
October	51	26	34.2	2,100	B.
November	32	20	25.6	1,520	C.
1908.					
April 5–30	150	20	67.0	3,460	B.
May	651	54	168	10,300	A.
June	768	150	483	28,700	B.
July	143	1	34.9	2,150	B.
August	15	0	4.11	253	D.
September	66	0	4.78	284	D.
October	58	27	43.1	2,650	B.
November 1–9	58	54	55.8	996	B.
The period				48,800	

AMERICAN FORK NEAR HARLOWTON, MONT.

American Fork rises in the Crazy Mountains and flows northeastward to its junction with the Musselshell, a few miles below the gaging station, which was established July 28, 1907, at the Shaw & Elliot ranch, 5 miles southeast of Harlowton, Mont., to determine the amount of water available for irrigation and storage.

American Fork has no important tributaries, but receives its water supply from the melting snow on the mountains. The basin of this stream affords some good storage sites, and by holding back the spring flood waters much more land can be put under irrigation.

Records obtained during the open season are good. The bed of the stream at the gaging station is composed of sand and clay, and shifts only under extreme conditions.

Discharge measurements of American Fork near Harlowton, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	J. E. Stewart	14	12.2	1.79	23.0
September 6	do	11	6.4	1.50	2.0
October 31	do	10	7.3	1.56	3.7
1908.					
April 28	Raymond Richards	5.5	2.2	1.46	[a] 2.7
June 5	do	36	125	3.68	508
June 23	J. E. Stewart	32	71.2	2.38	73.2
July 27 [a]	Raymond Richards	2	.45	1.51	.43
September 24	do				[b]

[a] Made by wading. [b] Stream dry.

NOTE.—The above measurements were made at various sections.

Daily gage height, in feet, of American Fork near Harlowton, Mont., for 1907 and 1908.

[Samuel A. Shaw, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907							1907.						
1	.....	1.85	1.5	1.5	1.55	1.55	16	.....	1.6	1.55	1.55	1.55	.....
2	.....	1.75	1.55	1.5	1.55	1.55	17	.....	1.6	1.5	1.55	1.55	.....
3	.....	1.85	1.5	1.5	1.55	1.55	18	.....	1.55	1.5	1.55	1.55	.....
4	.....	1.8	1.5	1.5	1.55	1.55	19	.....	1.55	1.5	1.55	1.55	.....
5	.....	1.65	1.5	1.5	1.55	1.55	20	.....	1.5	1.5	1.5	1.55	.....
6	.....	1.6	1.5	1.5	1.55	1.55	21	.....	1.5	1.5	1.5	1.55	.....
7	.....	1.6	1.5	1.5	1.55	1.55	22	.....	1.5	1.5	1.55	1.55	.....
8	.....	1.5	1.55	1.5	1.55	1.55	23	.....	1.5	1.5	1.6	1.55	.....
9	.....	1.5	1.55	1.5	1.55	.....	24	.....	1.5	1.5	1.6	1.55	.....
10	.....	1.8	1.5	1.5	1.55	.....	25	.....	1.5	1.5	1.55	1.55	.....
11	.....	2.0	1.55	1.5	1.55	.....	26	.....	1.5	1.5	1.55	1.55	.....
12	.....	1.8	1.65	1.5	1.55	.....	27	.....	1.5	1.5	1.6	1.55	.....
13	.....	1.8	1.65	1.5	1.55	.....	28	1.8	1.5	1.5	1.6	1.55	.....
14	.....	1.7	1.6	1.5	1.55	.....	29	1.75	1.5	1.5	1.6	1.55	.....
15	.....	1.65	1.55	1.55	1.55	.....	30	1.9	1.5	1.5	1.6	1.55	.....
							31	1.95	1.6	.....	1.6	.....	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	1.5	1.45	4.4	2.1	.....	.....	1.5	1.75
2	1.5	1.45	4.15	2.0	.....	.....	1.5	1.7
3	1.5	1.45	3.9	2.0	.....	.....	1.5	1.7
4	1.5	1.45	4.15	2.0	.....	.....	1.7	1.7
5	1.5	1.45	3.78	2.0	.....	.....	1.8	1.7
6	1.5	1.45	3.55	2.0	.....	.....	1.8	1.7
7	1.5	1.4	3.38	2.0	.....	.....	1.8	1.7
8	1.5	1.4	3.32	2.0	.....	.....	1.7	1.7
9	1.5	1.4	3.4	1.75	.....	.....	1.7	1.7
10	1.5	1.5	3.32	1.7	.....	.....	1.6	1.7
11	1.5	1.5	3.3	1.65	.....	.....	1.6	1.7
12	1.5	1.5	3.32	1.65	.....	.....	1.6	1.7
13	1.5	1.45	3.3	1.6	.....	.....	1.65	.....
14	1.5	1.45	3.12	1.6	.....	.....	1.65	.....
15	1.5	1.45	3.0	1.6	.....	.....	1.7	.....
16	1.5	1.45	3.05	1.5	.....	.....	1.7	.....
17	1.5	1.4	3.0	1.6	.....	.....	1.75	.....
18	1.45	1.4	2.9	1.6	.....	.....	1.75	.....
19	1.45	1.4	2.8	1.65	.....	.....	1.8	.....
20	1.45	1.45	2.8	1.65	.....	.....	1.8	.....
21	1.45	1.45	2.6	1.66	.....	.....	1.8	.....
22	1.45	1.45	2.5	1.5	.....	.....	1.8	.....
23	1.45	1.45	2.4	1.5	.....	.....	1.8	.....
24	1.45	1.45	2.2	1.5	.....	.....	1.8	.....
25	1.45	1.45	2.2	1.5	.....	.....	1.8	.....
26	1.5	1.45	2.15	1.55	.....	.....	1.8	.....
27	1.5	2.72	2.1	1.55	.....	.....	1.8	.....
28	1.5	2.48	2.2	1.5	.....	.....	1.8	.....
29	1.5	2.48	2.2	1.5	.....	.....	1.8	.....
30	1.5	2.78	2.2	1.5	.....	.....	1.75	.....
31	.....	3.75	.....	1.5	.....	.....	1.75	.....

NOTE.—Ice conditions December 9–31, 1907, January 1–March 31, 1908, and November 13–December 31, 1908. No flow August and September, 1908.

Rating tables for American Fork near Harlowton, Mont.

JULY 28 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	1.5	1.70	14	1.90	32	2.00	42
1.60	6.6	1.80	22.5				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and is not well defined.

APRIL 1 TO MAY 26, 1908.

1.40	1.0	1.50	4.3				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and is not well defined.

MAY 27 TO DECEMBER 31, 1908.

1.50	0.2	2.30	66	3.10	256	3.90	615
1.60	4.0	2.40	78	3.20	295	4.00	665
1.70	11	2.50	92	3.30	336	4.10	715
1.80	19	2.60	109	3.40	379	4.20	765
1.90	27	2.70	130	3.50	424	4.30	815
2.00	36	2.80	155	3.60	470	4.40	870
2.10	45	2.90	185	3.70	517		
2.20	55	3.00	219	3.80	565		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and the form of the previous curves and is not well defined.

Monthly discharge of American Fork near Harlowton, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
August	42.0	1.5	9.50	584
September	10.3	1.5	2.76	164
October	6.6	1.5	3.30	203
November	4.0	4.0	4.00	238
December 1–8	4.0	4.0	4.00	63
1908.				
April	4.3	2.6	3.85	229
May	541	1.0	34.4	2,120
June	870	45	284	16,900
July	45	.2	12.5	769
August	0	0	0	0
September	0	0	0	0
October	19	.2	13.2	812
November 1–12	15	11	11.3	269
The period				21,100

NOTE.—Owing to the shifting character of the stream bed, these estimates of monthly flow are only roughly approximate.

LEBO CREEK NEAR HARLOWTON, MONT.

Lebo Creek rises at an elevation of 5,600 feet, flows northeastward, and enters American Fork one-half mile below the gaging station. It is about 20 miles long, is fed by springs, and its flow is nearly uniform. Its water is used for irrigation.

The gaging station, which was established July 28, 1907, to determine the amount of water available for irrigation, is located near the Shaw & Elliott ranch, 5 miles southeast of Harlowton.

Records obtained are fair. The flow is affected by grass in the stream bed.

Discharge measurements of Lebo Creek near Harlowton, Mont., in 1906, 1907, and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 11	O. F. Wasmansdorf	.....	.....	.....	[a] 11.6
1907.					
July 28	J. E. Stewart	10	9.5	1.39	16.5
September 6	do	10	12.6	1.48	18.8
October 31	do	10	9.7	1.38	20.3
1908.					
April 28	Raymond Richards	7.5	8.0	1.08	14.1
June 5	do	10	14.4	1.97	33.5
June 23	J. E. Stewart	10	10.0	1.38	27.7
July 27	Raymond Richards	8	4.2	.73	8.8
September 24	do	8	3.4	.74	10.2

[a] Weir measurement.

NOTE.—The above measurements, except that for November 11, 1906, were made by wading at various sections.

Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1907 and 1908.

[Samuel A. Shaw, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1	.....	1.6	1.5	1.5	1.4	1.35	16	.....	1.6	1.55	1.4	1.4	.....
2	.....	1.5	1.5	1.5	1.4	1.35	17	.....	1.5	1.5	1.4	1.4	.....
3	.....	1.55	1.5	1.6	1.4	1.35	18	.....	1.45	1.55	1.4	1.45	.....
4	.....	1.4	1.5	1.5	1.4	1.35	19	.....	1.4	1.55	1.4	1.45	.....
5	.....	1.35	1.5	1.5	1.4	1.35	20	.....	1.4	1.5	1.35	1.4	.....
6	.....	1.3	1.5	1.5	1.4	1.35	21	.....	1.35	1.5	1.35	1.4	.....
7	.....	1.2	1.5	1.5	1.4	1.35	22	.....	1.3	1.5	1.35	1.35	.....
8	.....	1.1	1.5	1.5	1.4	1.35	23	.....	1.2	1.5	1.4	1.35	.....
9	.....	1.2	1.5	1.5	1.4	.....	24	.....	1.2	1.5	1.4	1.35	.....
10	.....	2.0	1.5	1.5	1.4	.....	25	.....	1.2	1.5	1.4	1.35	.....
11	.....	2.6	1.5	1.5	1.4	.....	26	.....	1.2	1.5	1.4	1.35	.....
12	.....	1.6	1.6	1.5	1.4	.....	27	.....	1.2	1.5	1.4	1.35	.....
13	.....	1.75	1.7	1.4	1.4	.....	28	1.4	1.3	1.5	1.4	1.35	.....
14	.....	1.6	1.6	1.4	1.4	.....	29	1.35	1.3	1.55	1.4	1.35	.....
15	.....	1.6	1.6	1.4	1.4	.....	30	2.25	1.3	1.55	1.4	1.35	.....
							31	1.85	1.5	.....	1.4	.....	.....

Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1907 and 1908— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	1.10	0.95	3.18	0.90	0.30	0.70	0.70	1.3
2	1.10	.95	2.35	.80	.30	.70	.70	1.3
3	1.10	1.0	2.1	.80	.30	.70	.70	1.3
4	1.05	1.0	2.4	.90	.30	.70	.80	1.3
5	1.05	1.0	2.05	.90	.30	.70	1.0	1.3
6	1.05	1.0	1.8	.90	.30	.70	1.0	1.3
7	1.05	.90	1.7	.80	.30	.70	1.0	1.3
8	1.05	.90	1.75	.80	.30	.70	.90	1.3
9	1.05	.90	1.75	.80	.30	.70	.85	1.3
10	1.05	1.05	1.7	.80	.30	.70	.85	1.3
11	1.05	1.1	1.6	.90	.30	.70	.85	1.3
12	1.05	1.0	1.5	.95	.70	.70	.85	1.3
13	1.05	.95	1.5	.90	.60	.70	.85	.....
14	1.05	.95	1.5	.90	.70	.70	.85	.....
15	1.05	.95	1.45	.80	.80	.70	.80	.....
16	1.05	.95	1.4	.80	.70	.70	.80	.....
17	1.0	.95	1.5	.80	.80	.70	.80	.....
18	1.0	.95	1.5	.80	.80	.70	.80	.....
19	1.0	.95	1.4	.80	.80	.70	.80	.....
20	1.0	1.0	1.5	.80	.75	.70	.80	.....
21	1.0	1.0	1.4	.80	.75	.70	.80	.....
22	1.0	.80	1.4	.80	.75	.70	.80	.....
23	1.0	.80	1.4	.80	.80	.70	1.0	.....
24	1.0	.75	1.3	.80	.80	.70	1.5	.....
25	.95	.75	1.3	.80	.80	.70	1.75	.....
26	1.0	.80	1.2	.75	.75	.70	1.75	.....
27	1.0	2.75	1.2	.75	.75	.70	1.5	.....
28	1.05	1.8	1.1	.75	.70	.70	1.25	.....
29	1.1	1.38	1.1	.70	.70	.70	1.25	.....
30	1.0	1.9	1.0	.60	.70	.70	1.25	.....
31	.....	5.3	.....	.40	.75	.....	1.3	.....

NOTE.—Ice conditions December 9–31, 1907; November 13–December 31, 1908.

MILK RIVER DRAINAGE BASIN.

DESCRIPTION.

Milk River is formed in the southern part of the Canadian Province of Alberta by the union of two streams, the North Fork and the South Fork, that rise in the undulating foothills of the Rocky Mountains in northeastern Montana, near the international boundary line. For about 100 miles from this junction the Milk flows eastward parallel to and on the northeastern side of the boundary; it then turns to the southeast, passes across the northern part of Montana, and discharges into the Missouri east of Glasgow.

The tributaries of Milk River, except Clear Creek near Yantic and North Fork at Chinook, are for the most part intermittent streams, but the drainage ways that carry them contain local water pockets which are used as watering places for stock.

From the point at which it leaves Canada and enters Montana to Yantic, 10 miles east of Havre, the Milk is bounded on both sides by high cliffs that rise 200 feet or more above the stream. At Yantic the cliffs recede and become less abrupt and the valley spreads out, and it

maintains a width from 3 to 4 miles to its lower end, where it narrows to a mile near Hinsdale. This wider part of the valley was probably the preglacial channel of this Missouri before it was turned aside by the ice sheet and forced to seek a new outlet eastward along the southern face of the glacier.

From the top of the cliffs the country has a rolling aspect, exhibiting no abrupt changes except where tributaries to the main river have eroded deep channels in passing from higher or bench lands to the valley. The general slope of the country is toward the east.

A deposit of glacial drift, varying from a layer so thin as to be unnoticeable to a bed 70 feet thick, covers the greater part of the drainage basin except along the streams, and many small ponds that dry up in summer time are scattered over the area. Most of these ponds occupy shallow depressions with no outlet, and their waters as a rule contain salts leached from the soil, and are therefore alkaline. Highly alkaline water was also obtained by a number of wells that have been sunk in the vicinity of Havre and Chinook.

The entire drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream.

The mean annual rainfall, which is about 14 inches at Havre, is 19 inches at the extreme western edge of the basin. As a rule most of this rainfall occurs during the months of May and June. As might be expected in this northern latitude, the streams and lakes are icebound from the last part of November to the first of April.

As the rainfall is so scanty, irrigation is necessary for successful cultivation of crops. The United States Reclamation Service has begun construction on an irrigation project that will store the flood water of Milk River, reinforce the discharge by water from St. Mary River, and ultimately reclaim 250,000 acres of land in the lower valley.

Reservoirs for the storage of flood waters are possible at a number of places in the basin, as at Chain Lakes, 30 miles northwest of Havre, and Mud Lake, in Tps. 31 and 32 N., Rs. 31 and 32 E., and at Lake Bowdoin and Lonesome Lake.

Natural power opportunities are wholly lacking in this basin, for the fall of none of the streams is large, and Milk River itself is apt to cease to flow in the late summer and autumn.

The longest run-off record extends back to 1898. The wettest year since that time was 1899 and the driest was 1905. The total flow of the river in the driest year was only one-thirtieth of that of the wettest.

The following gaging stations have been maintained in this river basin:

South Fork of Milk River near Browning, Mont., 1905–1908.
Milk River at Havre, Mont., 1898–1908.
Milk River at Chinook, Mont., 1897.
Milk River at Malta, Mont., 1902–1908.
Milk River at Hinsdale, Mont., 1908.
West Fork of Milk River at Chinook, Mont., 1906–1908.
North Fork of Milk River near Chinook, Mont., 1906–1908.
Beaver Creek near Ashfield, Mont., 1903–1906 and 1908.
Rock Creek near Hinsdale, Mont., 1905–7.
Porcupine Creek near Nashua, Mont., 1908.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

This station, which is located at Richard Croff's ranch, about 40 miles northeast of Browning, Mont., and about 6 miles south of the Canadian boundary line, was established April 28, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used above this station. A number of small ditches divert water to irrigate meadow lands in the river bottom, a considerable amount of this water returning to the stream as seepage and waste water.

The river overflows its banks at a gage height of 12 feet. During the high water of June, 1908, the gage was washed out and was not replaced until July 31, 1908. From high-water marks the stage was found to be 15.4 feet. The flood width was 850 feet and the flood cross section about 2,600 square feet.

On July 31 a new gage and cable were put in at their original locations. The datum of the gage remains the same.

The results are excellent except during the winter months, when they are affected by ice.

Discharge measurements of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	J. E. Stewart	58	157	5.29	442
June 8	J. B. Pierson	57	170	5.65	546
September 8	Follansbee and Pierson	42	42.6	3.66	50.0
1908.					
July 31[a]	Stewart and Huch	46	63.3	3.13	71.2
August 29[a]	do	28	43.1	2.90	41.0
October 9[a]	do	55	58.5	3.2	73.3

[a] Made by wading.

Daily gage height, in feet, of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

[R. J. Croff, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								
1	.....	4.28	4.65	4.62	3.70	3.90	3.80	3.65
2	.....	4.28	4.80	4.52	3.72	3.78	3.75	3.65
3	.....	4.35	4.75	4.48	3.80	3.72	3.75	3.65
4	.....	4.42	4.72	4.48	3.75	3.68	3.75	3.65
5	.....	4.42	4.60	4.42	3.72	3.65	3.70	3.65
6	.....	4.50	4.52	4.35	3.70	3.62	3.70	3.65
7	.....	4.52	4.88	4.28	3.75	3.75	3.78	3.65
8	.....	5.08	5.60	4.25	3.75	3.62	3.80	3.65
9	5.05	5.88	5.25	4.32	3.75	3.65	3.75	3.65
10	4.95	5.28	4.75	4.30	3.75	3.65	3.78	3.65
11	4.85	5.22	4.62	4.25	3.70	3.82	3.70	3.58
12	4.75	5.32	4.60	4.22	3.70	3.88	3.70	3.55
13	4.68	4.82	4.62	4.20	3.75	3.92	3.70	3.42
14	4.72	4.60	4.55	4.25	3.70	3.98	3.70	3.42
15	4.70	4.72	4.42	4.30	3.78	4.05	3.65	3.58
16	4.55	5.00	4.52	4.42	3.75	4.25	3.65	3.65
17	4.40	5.38	4.50	4.35	3.70	4.75	3.65	3.65
18	4.32	5.25	4.38	4.25	3.65	4.68	3.65	3.45
19	4.20	4.98	4.30	4.18	3.62	4.22	3.65	3.45
20	4.10	4.95	4.30	4.12	3.65	4.22	3.65	3.65
21	4.32	4.92	4.42	4.10	3.62	4.15	3.65	3.65
22	4.30	4.78	7.90	4.18	3.60	4.05	3.65	3.65
23	4.50	4.72	8.45	4.12	3.62	3.88	3.65	3.65
24	4.32	4.75	6.32	4.05	3.55	3.82	3.65	.....
25	4.20	4.62	5.35	3.98	3.52	3.85	3.65	.....
26	4.18	4.52	4.98	3.92	3.58	3.80	3.65	.....
27	4.05	4.45	4.90	3.88	3.65	3.82	3.65	.....
28	3.75	4.50	4.82	3.90	3.78	3.78	3.65	.....
29	4.02	4.70	4.68	3.78	3.80	3.80	3.65	.....
30	4.28	4.68	4.60	3.72	3.82	3.72	3.65	.....
31	.....	4.70	.....	3.75	3.92	.....	3.65	.....
1908.								
1	6.05	4.10	7.55	.....	3.20	2.90	3.40	3.45
2	5.88	4.15	7.40	.....	3.20	2.90	3.40	3.50
3	6.05	4.12	5.90	.....	3.20	2.90	3.30	3.40
4	6.10	4.18	8.55	.....	3.20	2.90	3.30	3.40
5	5.98	4.32	10.45	.....	3.20	2.80	3.55	3.40
6	5.85	4.12	(a)	.....	3.20	2.80	3.70	3.40
7	5.72	4.15	.....	.....	3.20	2.80	3.60	3.30
8	5.80	4.18	.....	.....	3.20	2.80	3.60	3.20
9	5.82	4.25	.....	.....	3.20	2.80	3.50	3.20
10	5.72	4.50	.....	.....	3.20	2.80	3.40	3.20
11	5.62	4.40	.....	.....	3.20	2.75	3.35	3.10
12	5.60	4.75	.....	.....	3.20	2.70	3.30	3.10
13	5.52	4.95	.....	.....	3.20	2.70	3.10	3.10
14	5.48	5.10	.....	.....	3.20	2.70	3.00	3.20
15	5.95	5.65	.....	.....	3.20	2.70	3.10	3.20
16	4.88	5.60	.....	.....	3.20	2.70	3.10	3.20
17	4.80	4.65	.....	.....	3.10	2.80	3.10	3.20
18	4.62	4.45	.....	.....	3.10	2.90	3.10	3.30
19	4.58	4.35	.....	.....	3.10	3.05	3.00	3.50
20	4.50	4.50	.....	.....	3.10	3.00	2.90	3.50
21	4.42	4.45	.....	.....	3.10	2.90	2.90	3.50
22	4.30	4.50	.....	.....	3.10	2.80	2.90	3.50
23	5.22	4.40	.....	.....	3.10	2.90	3.00	3.50
24	4.15	4.35	.....	.....	3.10	3.00	3.00	3.50
25	4.00	4.45	.....	.....	3.10	2.90	3.00	3.50
26	4.00	5.30	.....	.....	3.10	2.90	3.00	3.40
27	4.20	5.70	.....	.....	3.10	3.00	3.05	3.40
28	4.22	5.65	.....	.....	3.10	3.40	3.10	3.30
29	4.22	4.90	.....	.....	3.05	3.70	3.15	3.30
30	4.15	4.75	.....	.....	2.90	3.50	3.20	3.30
31	.....	5.35	.....	.....	2.90	.....	3.30	.....

a Gage washed out June 6, 1908. Maximum high-water gage height for June 6, 1908, as determined from high-water marks was 15.4 feet.

NOTE.—Ice conditions November 24 to December 31, 1907, and December, 1908.

Rating tables for South Fork of Milk River near Browning, Mont.

JANUARY 1, 1907, TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	20	4.60	245	5.80	597	7.00	1,010
3.50	28	4.70	272	5.90	629	7.20	1,090
3.60	40	4.80	299	6.00	662	7.40	1,175
3.70	53	4.90	327	6.10	695	7.60	1,265
3.80	68	5.00	355	6.20	728	7.80	1,360
3.90	85	5.10	384	6.30	762	8.00	1,460
4.00	104	5.20	413	6.40	796	8.20	1,560
4.10	125	5.30	443	6.50	831	8.40	1,665
4.20	147	5.40	473	6.60	866	8.60	1,775
4.30	170	5.50	503	6.70	901		
4.40	194	5.60	534	6.80	937		
4.50	219	5.70	565	6.90	973		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1906–7. It is well defined between gage heights 3.2 feet and 6.0 feet.

JULY 31, 1908, TO NOVEMBER 30, 1908.

2.70	25	3.00	52	3.30	96	3.60	153
2.80	32	3.10	65	3.40	113	3.70	176
2.90	41	3.20	80	3.50	132		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined.

Monthly discharge of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

[Drainage area 283 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 9–30	370	60	67.0	0.272	0.22	2,920	A.
May	623	165	301	1.06	1.22	18,500	A.
June	1,690	170	378	1.34	1.50	22,500	A.
July	250	56	148	.523	.60	9,100	A.
August	89	30	54.6	.193	.22	3,360	A.
September	286	43	93.9	.332	.37	5,590	A.
October	68	46	51.8	.183	.21	3,190	A.
November 1–23	46	22	40.8	.144	.12	1,860	A.
The period						67,000	
1908.							
April	695	104	402	1.42	1.58	23,900	A.
May	565	125	267	.943	1.09	16,400	A.
August	80	41	71.0	.251	.29	4,370	A.
September	176	25	47.1	.166	.19	2,800	B.
October	176	41	84.5	.299	.34	5,200	A.
November	132	65	103	.364	.41	6,130	B.
The period						58,800	

MILK RIVER AT HAVRE, MONT.

This station, which is located at the highway bridge over Milk River at Havre, Mont., was established May 15, 1898, to obtain data for use in connection with a storage project for irrigation in

Milk River valley. The nearest important tributaries enter about 20 miles east of the station.

The drainage area above Havre is about 7,300 miles, but the entire run-off from this area does not pass Havre, as an elaborate canal system in southern Alberta is supplied by Milk River. The theoretical discharge of the main canal of this system is about 330 second-feet of the low-water flow and 1,500 second-feet of the high-water discharge. As the system has not been wholly in operation the full effect of the diversions on the flow of Milk River has not yet been felt at Havre.

There are no other important irrigation rights above Havre, but farther downstream are five large canal systems supplied directly from Milk River and irrigating about 22,000 acres. The water rights of these various systems have not yet been adjudicated although preliminary steps have been taken. A suit in behalf of the Fort Belknap Indians was decided in their favor, with the result that they were given a prior right over the other canals to 125 second-feet, the priority of the other rights not being touched upon. Although no provision for storage has been made by the above claimants, the entire unappropriated flow of the stream has been filed upon by the United States Reclamation Service in connection with its Milk River irrigation project, which is now under construction.

The gage datum has not been changed since the station was established. From the last part of November to the first part of April the river at Havre is frozen entirely over and in portions of the cross sections it is usually frozen to the bottom.

Frequent discharge measurements are necessary at this station, and even with these the estimates are subject to considerable error. This characteristic is true of the entire river. In dry years the flow ceases entirely and the water stands in pools for several months.

Discharge measurements of Milk River at Havre, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 2	Follansbee and Pierson	117	370	5.75	993
Do	do	121	415	5.93	1,170
April 5	do	178	1,270	9.72	3,520
Do	do	173	1,130	9.35	3,100
April 6	J. B. Pierson	168	1,150	9.04	2,910
April 12	do	160	432	6.30	1,300
April 19	do	124	268	5.16	622
April 25	do	126	236	4.60	356
May 4	do	123	209	4.27	300
May 15	do	138	271	4.98	601
May 21	Robert Follansbee	145	354	5.13	765
May 23	J. B. Pierson	118	315	4.94	650
May 27	do	136	286	4.79	487
May 31	do	132	255	4.53	437
June 15	do	137	313	4.75	554
June 24	do	161	557	6.00	1,260
June 26	do	169	1,030	8.29	2,860
June 27	Follansbee and Pierson	160	429	5.75	1,270
July 15	J. B. Pierson	142	229	4.45	404
July 19	do	114	174	4.18	280

Discharge measurements of Milk River at Havre, Mont., in 1907 and 1908—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 2	J. B. Pierson	105	111	3.57	128
August 22[a]	do	40	48.5	3.19	57
August 29[a]	do		43.7	3.07	42
September 12	do	95	68	3.44	92
September 26	Robert Follansbee	112	148	3.93	197
October 19	Follansbee and Stewart	90	75	3.32	67
1908.					
April 4	Stewart and Huch	105	150	4.20	222
Do	do	119	176	4.35	260
April 25	A. F. Huch	104	188	4.39	348
May 22	do	106	257	4.70	478
June 4	do	149	293	5.11	571
June 27	do	137	324	5.10	840
August 5	do	70	111	4.01	204
October 27[a]	do	63	90.5	3.97	144

[a] Made by wading.

Daily gage height, in feet, of Milk River at Havre, Mont., for 1907 and 1908.

[L. H. Ling, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	5.4	5.55	4.3	4.5	5.4	3.5	3.1	3.7	3.2	3.4
2	.....	.....	5.8	4.3	4.4	5.0	3.5	3.1	3.65	3.2	3.45
3	.....	.....	7.4	4.3	4.4	4.9	3.4	3.1	3.6	3.25	3.45
4	.....	5.4	8.35	4.2	4.35	4.8	3.5	3.2	3.45	3.25	.....
5	.....	.....	9.93	4.1	4.4	4.7	3.4	3.25	3.5	3.25	.....
6	.....	.....	8.94	4.1	4.4	4.7	3.3	3.0	3.35	3.25	.....
7	.....	.....	8.2	4.2	4.4	4.6	3.4	3.35	3.4	3.25	.....
8	.....	.....	7.7	4.3	4.5	4.6	3.4	3.35	3.35	3.3	.....
9	.....	5.5	8.3	4.4	4.7	4.6	3.2	3.35	3.45	3.3	.....
10	3.4	.....	7.7	4.6	4.6	4.6	3.3	3.4	3.35	3.1	.....
11	3.8	.....	7.7	4.2	4.5	4.6	3.2	3.4	3.4	3.15	.....
12	4.9	.....	6.3	4.2	4.4	4.5	3.1	3.4	3.35	3.15	.....
13	4.5	.....	6.7	5.3	4.4	4.5	3.2	3.5	3.4	3.15	.....
14	4.4	.....	6.6	4.9	4.4	4.5	3.2	3.65	3.35	3.2	.....
15	8.0	.....	5.9	4.8	4.7	4.4	3.1	3.8	3.3	3.2	.....
16	7.5	.....	5.5	4.9	4.7	4.65	3.1	3.9	3.35	3.15	.....
17	7.7	.....	5.4	4.9	4.4	4.4	3.1	3.8	3.3	3.15	.....
18	7.5	.....	5.2	4.7	4.4	4.2	3.0	3.75	3.25	3.15	.....
19	7.5	.....	5.0	4.7	4.4	4.2	3.1	3.7	3.25	3.25	.....
20	7.2	.....	4.9	4.5	4.3	4.1	3.0	3.6	3.25	3.35	.....
21	7.3	6.6	4.7	5.0	4.2	4.1	3.1	3.5	3.25	3.45	.....
22	7.2	7.8	4.5	5.1	4.2	4.0	3.1	3.65	3.25	3.4	.....
23	7.3	6.8	4.5	4.9	9.9	4.3	3.1	3.7	3.25	3.4	.....
24	7.2	10.1	4.6	4.9	6.4	4.1	3.05	4.25	3.25	3.4	.....
25	7.3	8.5	4.5	4.95	6.7	4.0	3.05	4.05	3.25	3.4	.....
26	.....	6.2	4.4	4.9	8.9	3.9	3.05	4.0	3.25	3.4	.....
27	.....	6.0	4.4	4.8	6.85	3.8	3.0	3.85	3.2	3.4	.....
28	.....	5.4	4.3	4.7	6.0	3.8	3.0	3.8	3.2	3.4	.....
29	.....	5.9	4.3	4.5	5.8	3.7	3.0	3.8	3.2	3.4	.....
30	.....	5.3	4.6	4.6	5.8	3.7	3.1	3.7	3.2	3.4	.....
31	.....	5.6	.....	4.5	.....	3.6	3.15	.....	3.2	.....	.....
1908.											
1	.....	.....	.....	4.2	5.6	5.1	4.1	3.85	3.95	4.5	.....
2	.....	.....	.....	4.2	5.0	5.1	4.1	3.85	4.0	4.45	.....
3	.....	.....	4.1	4.1	5.0	5.1	4.0	3.85	4.1	4.45	.....
4	.....	.....	4.3	4.05	7.4	5.0	4.0	3.8	4.2	4.46	.....
5	.....	.....	4.7	4.0	8.0	4.98	4.0	3.76	4.3	4.7	.....
6	.....	4.1	4.9	4.0	7.4	4.93	4.0	3.75	4.35	4.65	.....
7	.....	.....	4.7	3.9	10.6	4.9	4.0	3.75	4.3	4.6	.....
8	.....	.....	4.5	3.9	12.45	4.8	3.9	3.75	4.3	4.5	.....
9	.....	4.1	4.9	3.9	[a]14.80	4.8	3.9	3.72	4.2	4.4	.....
10	.....	4.2	4.7	3.9	13.5	4.8	3.9	3.71	4.2	4.2	.....

[a] Maximum gage height June 9, 1908, was 16.5 feet.

Daily gage height, in feet, of Milk River at Havre, Mont., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.											
11	.....	4.2	4.5	3.9	9.45	4.8	3.8	3.7	4.2	4.0	.....
12	.....	4.2	4.4	3.9	7.9	4.78	3.8	3.7	4.2	4.0	.....
13	.....	4.4	4.3	3.95	7.2	4.7	3.9	3.7	4.25	.....	.....
14	.....	4.4	4.2	4.0	6.9	4.6	3.9	3.69	4.35	.....	.....
15	.....	4.4	4.1	4.0	6.6	4.5	3.9	3.68	4.3	.....	.....
16	.....	4.1	4.1	4.1	6.4	4.4	3.9	3.68	4.0	.....	.....
17	.....	4.2	4.2	4.5	6.4	4.4	3.95	3.68	3.95	3.9	.....
18	.....	4.2	4.2	4.5	6.2	4.4	3.8	3.68	3.9	3.9	.....
19	.....	4.15	4.1	5.1	5.9	4.4	3.8	3.75	3.9	3.9	.....
20	.....	4.05	4.0	4.95	5.7	4.8	3.9	3.75	3.9	3.9	.....
21	.....	4.2	4.2	4.8	5.6	4.7	3.9	3.75	3.85	4.9	.....
22	.....	4.1	4.2	4.75	5.5	4.6	3.9	3.68	3.82	4.5	.....
23	.....	4.4	4.2	4.5	5.5	4.6	3.9	3.6	3.75	4.4	.....
24	.....	4.0	4.1	4.45	5.45	4.5	3.9	3.62	3.65	4.2	.....
25	.....	3.9	4.1	4.45	5.4	4.5	3.9	3.7	3.65	.....	.....
26	.....	4.2	4.1	4.45	5.2	4.4	3.8	3.85	3.65	.....	.....
27	.....	.....	4.5	4.4	5.2	4.38	3.8	3.85	3.9	.....	.....
28	.....	.....	4.3	4.4	5.1	4.2	3.8	3.85	4.2	.....	.....
29	.....	.....	4.2	4.4	5.1	4.18	3.8	3.9	4.2	4.0	.....
30	.....	.....	4.2	4.45	5.1	4.2	3.8	3.9	4.2	.....	.....
31	.....	.....	.....	5.45	.....	4.2	3.8	.....	4.5	.....	.....

NOTE.—Ice conditions: River frozen to the bottom (no flow) January 1–February 9, 1907. River open February 10–22; frozen from February 23–March 23, and December, 1907–March 13, 1908, November 13–16 and November 25–December 31, 1908.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	.....	910	300	430	1,000	110	50	145	62
2	.....	1,100	300	390	760	110	50	135	62
3	.....	2,040	310	390	648	90	50	130	68
4	.....	2,650	280	368	638	105	60	100	68
5	.....	3,500	255	390	580	90	66	105	68
6	.....	2,850	255	390	565	72	40	80	68
7	.....	2,400	280	390	520	90	81	90	68
8	.....	2,120	315	430	505	90	81	80	75
9	.....	2,520	350	512	505	60	81	100	75
10	.....	2,140	430	467	490	72	90	80	50
11	.....	2,160	280	430	490	60	90	90	55
12	.....	1,300	280	390	440	50	90	80	55
13	.....	1,560	760	390	440	60	110	90	55
14	.....	1,490	560	390	430	60	135	80	62
15	.....	1,040	510	512	387	50	168	75	62
16	.....	810	580	520	480	50	192	80	55
17	.....	760	590	400	370	50	168	75	55
18	.....	650	510	400	290	40	155	68	55
19	.....	550	520	400	287	50	145	68	68
20	.....	490	440	360	250	40	130	68	80
21	1,540	400	710	325	250	50	110	68	100
22	2,300	330	740	325	225	50	135	68	90
23	1,660	330	640	3,720	310	50	145	68	90
24	3,750	360	620	1,510	250	45	288	68	90
25	2,750	330	615	1,760	225	45	230	68	90
26	1,290	300	560	3,160	200	45	218	68	90
27	1,160	310	500	1,580	172	40	180	62	90
28	800	275	460	1,400	172	40	168	62	90
29	1,100	290	390	1,270	150	40	168	62	90
30	940	390	445	1,250	150	50	145	62	90
31	910	.....	420	.....	130	55	.....	62	.....
1908.									
1	.....	.....	290	1,000	810	230	150	155	285
2	.....	.....	290	660	810	230	150	165	270
3	.....	208	250	660	810	205	150	190	270
4	.....	254	242	2,150	750	205	140	215	272
5	.....	375	230	2,580	740	205	130	242	350

Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
6	.....	450	230	2,150	700	205	130	260	330
7	.....	375	205	4,720	685	205	125	240	315
8	.....	335	205	6,500	630	188	125	240	285
9	.....	485	205	9,600	630	188	120	200	255
10	.....	408	205	7,600	630	188	118	200	200
11	.....	335	205	3,700	610	155	115	200	150
12	.....	320	205	2,500	600	155	115	200	150
13	.....	285	215	2,020	565	188	115	210	.....
14	208	255	230	1,850	515	188	112	240	.....
15	208	230	230	1,660	470	188	110	225	.....
16	208	235	250	1,540	410	188	110	155	.....
17	228	265	395	1,540	410	192	110	145	135
18	228	265	395	1,430	410	155	110	135	135
19	218	235	660	1,260	410	155	125	135	135
20	197	220	585	1,160	585	188	125	135	135
21	228	280	515	1,110	510	188	125	125	135
22	208	280	490	1,050	465	165	110	120	135
23	280	280	395	1,050	465	165	90	110	135
24	190	250	380	1,020	430	165	95	90	135
25	170	250	350	1,000	430	165	108	90	.....
26	228	250	350	840	360	140	135	90	.....
27	.....	390	320	840	350	140	135	135	.....
28	.....	320	320	820	290	140	135	200	.....
29	.....	290	310	820	280	140	145	200	.....
30	.....	290	325	820	290	140	145	200	.....
31	.....	.....	760	.....	290	140	.....	285	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Milk River at Havre, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
February	.....	.....	800	44,400
March	3,750	.....	845	52,000
April	3,500	275	1,210	72,000
May	760	255	458	28,200
June	3,720	325	822	48,900
July	1,000	130	397	24,400
August	110	40	61.6	3,790
September	288	40	127	7,560
October	145	62	81.8	5,030
November	100	50	72.5	4,310
December	.....	.....	60	3,690
The period	3,750	.....	411	294,000
1908.				
March	280	170	212	13,000
April	485	208	295	17,600
May	760	205	330	20,300
June	9,600	660	2,190	130,000
July	810	280	527	32,400
August	230	140	177	10,900
September	150	90	124	7,380
October	285	90	178	10,900
November	350	135	186	11,100
The period	.....	.....	.....	254,000

NOTE.—Discharge estimated for ice periods in February, March, and December, 1907, and March and November, 1908; also for April 1 and 2, 1908.

Owing to the shifting character of the stream bed, these estimates of monthly flow are only roughly approximate.

MILK RIVER AT MALTA, MONT.

This station, which is located at the highway bridge at Malta, Mont., was established July 31, 1902, to obtain data for irrigation projects in Milk River valley. The nearest tributaries above the station are West and North forks of Milk River, which enter about 60 miles west of Malta.

The drainage area above is about 14,000 square miles, but the entire run-off does not pass this station, for between Havre and Malta seven irrigation canals, which irrigate about 25,000 acres of land, divert water from Milk River and its tributaries. The United States Reclamation Service has under construction a diversion dam at Dodson, about 17 miles above the station, which diverts water for the irrigation of about 108,000 acres of land in Milk River valley east of Malta. There are two canals, one on each side, with a total discharge of 1,000 second-feet.

The gage datum has not been changed since the station was established. From November until April the gage heights are affected by ice, so that estimates of run-off are only approximate.

Discharge measurements of Milk River at Malta, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 3 [a]	Follansbee and Pierson	164	1,330	10.86	3,000
April 7 [b]	do	203	3,000	19.11	10,200
April 8	J. B. Pierson	203	2,860	18.85	10,600
April 16	do	169	1,490	11.26	5,870
April 26	do	164	1,310	9.99	5,050
May 2	do	121	380	4.38	1,530
May 17	do	118	348	4.17	1,490
May 28	do	133	451	4.90	2,000
June 18	do	116	343	4.09	1,420
July 10	do	104	251	3.35	813
July 31	do	85	138	2.20	283
August 20	do	78	86	1.54	82
August 28 [c]	do	57	42	1.35	68
October 21	Follansbee and Stewart	79	91	1.71	100
1908.					
April 8	Stewart and Huch	90	175	2.61	408
April 24	A. F. Huch	80	108	1.75	165
May 8	do	75	78	1.49	81.6
May 11	Stewart and Huch	73	72.5	1.40	72.4
May 28 [d]	A. F. Huch	81	105	2.20	158
June 8	do	142	490	5.05	2,100
June 26	do	125	347	3.72	1,320
July 9	do	87	161	2.37	317
August 11 [c]	do	75	133	1.72	113
September 29 [c]	do	75	120	1.55	117

[a] River gorged with ice. [b] Floating ice. [c] Made by wading. [d] Rejected.

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Daily gage height, in feet, of Milk River at Malta, Mont., for 1907 and 1908.

[M. J. Larson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		19.88	4.50	3.50	5.60	1.90	2.35	2.05	1.72	.....
2		19.45	4.40	3.55	5.05	1.95	1.85	2.00	1.75	.....
3		10.85	4.15	3.50	4.78	1.92	1.70	1.95	1.78	.....
4		14.40	3.80	3.42	4.55	1.90	1.55	1.85	.....	.....
5		17.95	3.45	3.35	4.20	1.80	1.50	1.82	1.80	.....
6		19.45	3.22	3.28	3.92	1.72	1.48	1.80	1.80	.....
7		19.30	3.50	3.20	3.80	1.72	1.42	1.78	.....	.....
8		18.82	3.92	3.15	3.68	1.78	1.40	.....	.....	.....
9		19.02	3.90	3.10	3.52	1.70	.....	1.75	1.70	.....
10		19.75	3.85	3.00	3.38	1.68	1.35	1.75	.....	.....
11		19.48	3.82	3.05	3.35	1.65	.....	.....	1.65	.....
12		18.65	3.75	3.00	3.30	1.62	1.48	1.72	.....	.....
13		17.28	3.80	3.10	3.18	.....	1.55	1.72	1.60	.....
14		14.10	3.95	3.25	3.05	1.58	1.60	1.70	.....	.....
15		11.55	4.10	3.30	3.12	.....	1.70	1.70	1.58	.....
16		11.20	4.20	3.78	3.22	1.50	1.72	1.70	1.58	.....
17		11.80	4.22	4.30	3.35	.....	1.78	1.68	1.52	.....
18		11.32	4.10	4.10	3.15	1.45	1.80	.....	1.52	.....
19		9.95	3.95	3.78	3.08	1.42	1.75	1.70	.....	.....
20		9.00	3.90	3.45	3.02	1.55	1.80	.....	1.50	.....
21		9.00	3.88	3.40	2.90	1.58	1.85	1.70	.....	.....
22		7.50	3.82	3.20	2.85	1.52	1.90	1.70	1.50	.....
23		8.75	3.90	3.25	2.75	1.45	.....	.....	.....	.....
24		9.65	4.20	5.60	2.68	.....	1.88	1.68	1.50	.....
25	13.98	10.88	5.35	8.08	2.60	1.40	1.80	.....	.....	.....
26	13.45	10.18	5.30	11.18	2.52	1.40	1.75	1.65	1.48	.....
27	12.00	9.45	5.25	9.05	2.50	1.38	1.82	.....	.....	.....
28	11.45	7.62	4.90	8.20	2.45	1.35	1.90	1.68	1.48	.....
29	11.10	5.20	4.52	7.30	2.35	1.35	2.02	.....	.....	.....
30	20.90	5.08	4.20	6.48	2.28	1.45	2.05	1.70	1.45	.....
31	21.35	.....	3.90	.....	2.15	2.50	.....	1.72	.....	.....
1908.										
1	.....	.....	1.50	2.50	3.22	1.92	1.75	1.55	1.90	1.85
2	.....	.....	1.48	2.60	3.15	1.82	1.78	1.50	1.95	1.90
3	.....	.....	1.48	2.72	3.05	1.70	1.75	1.58	2.00	1.98
4	.....	.....	1.50	2.85	2.88	1.55	1.70	1.55	2.05	.....
5	.....	.....	1.50	3.12	2.75	1.70	1.68	1.60	2.10	1.90
6	.....	.....	1.50	3.48	2.68	1.75	1.68	1.65	2.12	.....
7	.....	.....	1.50	4.15	2.60	1.72	1.70	1.72	2.20	1.80
8	.....	2.68	1.48	4.55	2.45	1.75	1.70	1.72	2.22	.....
9	.....	2.82	1.45	6.42	2.32	1.72	1.68	1.80	.....	1.62
10	.....	3.05	1.40	8.25	2.30	1.72	1.65	1.85	2.20	.....
11	.....	3.08	1.38	9.68	2.22	1.70	1.60	1.90	2.18	.....
12	.....	3.02	1.30	10.95	2.18	1.72	1.55	1.95	2.18	1.48
13	.....	2.90	1.30	[a] 12.08	2.08	1.70	1.50	.....	2.15	.....
14	.....	2.75	1.28	11.32	2.00	1.70	1.50	1.95	2.18	1.40
15	.....	2.62	1.25	8.42	2.00	1.70	1.52	1.92	2.18	.....
16	.....	2.50	1.20	6.85	1.98	1.68	1.50	1.95	2.18	1.55
17	.....	2.38	1.18	6.60	1.98	1.62	1.50	1.98	2.15	1.70
18	.....	2.12	1.15	6.28	1.92	1.55	1.52	1.98	.....	.....
19	.....	2.02	1.12	6.05	1.92	1.52	1.50	2.00	2.15	.....
20	.....	1.92	1.10	5.75	1.90	1.52	1.50	.....	.....	1.75
21	.....	2.35	1.45	5.15	1.92	1.60	1.48	2.10	2.12	.....
22	.....	2.15	1.90	4.42	2.05	1.62	1.50	2.05	2.12	1.82
23	.....	1.95	2.10	4.20	2.10	1.75	1.55	2.00	2.22	.....
24	.....	1.78	2.25	3.92	2.05	1.78	1.60	2.02	.....	.....
25	.....	1.62	2.40	3.70	2.00	1.80	1.65	2.00	2.35	2.00
26	.....	1.65	2.15	3.72	2.02	1.72	1.70	1.95	2.38	.....
27	.....	1.58	1.98	3.65	2.08	1.75	1.62	1.92	2.55	.....
28	.....	1.50	2.20	3.48	2.07	1.75	1.62	1.90	2.22	1.92
29	.....	1.55	2.00	3.38	2.05	1.70	1.60	1.88	1.88	.....
30	.....	1.50	2.45	3.25	2.02	1.72	1.58	1.85	1.85	.....
31	.....	.....	2.50	.....	2.02	1.70	.....	1.88	.....	2.10

[a] Maximum gage height June 13 was 12.25 feet.

NOTE.—Ice conditions January 1–April 4 (approximately) 1907 and during December, 1907. Probable ice conditions January 1–April 7, 1908. During December, 1908, the river was frozen over except at the riffle where the gage is located.

Rating table for Milk River at Malta, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	55	2.80	559	4.60	1,688	7.60	3,578
1.40	67	2.90	618	4.80	1,814	7.80	3,704
1.50	82	3.00	680	5.00	1,940	8.00	3,830
1.60	100	3.10	743	5.20	2,066	9.00	4,460
1.70	121	3.20	806	5.40	2,192	10.00	5,090
1.80	145	3.30	869	5.60	2,318	11.00	5,720
1.90	172	3.40	932	5.80	2,444	12.00	6,350
2.00	202	3.50	995	6.00	2,570	13.00	6,980
2.10	235	3.60	1,058	6.20	2,696	14.00	7,610
2.20	272	3.70	1,121	6.40	2,822	15.00	8,240
2.30	312	3.80	1,184	6.60	2,948	16.00	8,870
2.40	355	3.90	1,247	6.80	3,074	17.00	9,500
2.50	401	4.00	1,310	7.00	3,200	18.00	10,130
2.60	450	4.20	1,436	7.20	3,326	19.00	10,760
2.70	503	4.40	1,562	7.40	3,452	20.00	11,390

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 13 discharge measurements made during 1907, and is well defined.

FOR 1908.

[Indirect method for shifting channels used during 1908.]

Daily discharge, in second-feet, of Milk River at Malta, Mont., for 1908.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	98	401	899	165	140	114	200
2	.....	93	450	834	135	150	104	218
3	.....	90	503	751	112	140	119	232
4	.....	90	589	626	80	130	114	249
5	.....	87	740	531	112	127	124	266
6	.....	84	995	477	123	127	136	275
7	.....	82	1,400	430	113	130	151	310
8	445	79	1,660	348	123	130	151	315
9	530	74	2,820	295	113	127	172	312
10	682	67	4,000	290	113	125	186	310
11	762	65	4,890	260	110	116	200	300
12	672	55	5,720	244	113	104	218	300
13	612	55	6,410	212	110	94	218	290
14	525	53	5,900	188	110	94	218	300
15	460	49	4,070	188	110	98	209	300
16	405	44	3,100	182	106	94	218	300
17	365	42	2,950	182	95	94	226	290
18	260	39	2,760	165	82	98	226	290
19	232	36	2,600	165	80	94	232	290
20	200	34	2,410	160	85	104	249	282
21	375	74	2,030	165	100	100	266	275
22	290	172	1,560	202	104	104	249	275
23	226	235	1,440	218	133	114	232	315
24	175	292	1,250	202	140	124	239	345
25	140	355	1,120	188	145	137	232	380
26	142	253	1,120	196	126	149	218	392
27	119	196	1,090	212	133	130	209	470
28	100	272	990	210	133	130	200	315
29	110	202	930	202	121	124	193	193
30	100	382	836	196	126	119	186	186
31	.....	410	.....	196	128	.....	193	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Milk River at Malta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	11,200	1,990	6,430	383,000	A.
May	2,160	819	1,390	85,500	A.
June	5,830	680	1,600	95,200	A.
July	2,320	254	883	54,300	B.
August	401	61	113	6,950	D.
September	334	61	132	7,860	D.
October	218	110	133	8,180	D.
November	145	74	102	6,070	D.
The period				647,000	
1908.					
April [a]	762	100	354	21,100	C.
May	410	34	134	8,240	C.
June	6,410	401	2,220	132,000	B.
July	899	160	310	19,100	B.
August	165	80	115	7,070	B.
September	150	94	118	7,020	C.
October	266	104	194	11,900	C.
November	470	186	292	17,400	D.
The period				224,000	

[a] Discharge for April 1–7 estimated.

MILK RIVER AT HINSDALE, MONT.

This station, which is located at the highway bridge over Milk River, about 1 mile from Hinsdale, Mont., a point 46 miles from its junction with Missouri River, was established May 13, 1908, to obtain data for use in connection with irrigation projects in Milk River valley.

Three tributaries enter between Malta and Hinsdale: Beaver Creek from the south and Frenchman and Rock creeks from the north. These streams discharge large volumes of water during the rainy weather in the spring and summer, but they are low or even dry during the fall and winter months.

No diversions are made between Malta and Hinsdale. The United States Reclamation Service has appropriated the flow of the stream in connection with the Milk River project and will divert it at a point 9 miles east of Hinsdale to irrigate land in lower Milk River valley.

From late in November until the 1st of April the stream is frozen entirely across and to a considerable depth. It is impracticable to keep gage records here during this period.

Discharge measurements of Milk River at Hinsdale, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14 [a]	Stewart and Huch	99	156	1.98	118
May 27 [b]	A. F. Huch	85	278	[c] 2.93	367
June 9	do	134	994	4.91	1,620
June 25	do	127	961	4.49	1,273
July 8	do	123	776	[c] 3.08	472
Aug. 10 [a]	do	95	138	2.11	163
Sept. 28 [a]	do	64	100	1.70	72

[a] Made by wading. [b] Made from boat. [c] Gage height doubtful.

Daily gage height, in feet, of Milk River at Hinsdale, Mont., for 1908.

[M. F. Chester, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.00	3.80	1.95	2.26	1.30	1.85	16	1.95	9.30	2.45	1.51	1.56	1.80	2.05
2	.....	1.90	3.60	2.00	1.96	1.30	1.85	17	1.90	7.50	2.45	1.71	1.56	1.80	2.10
3	.....	1.90	3.50	2.00	1.96	1.30	1.85	18	1.90	6.50	2.35	1.96	1.56	1.80	2.10
4	.....	2.00	3.40	2.00	1.91	1.35	1.80	19	1.85	5.70	2.30	2.01	1.56	1.80	.....
5	.....	2.10	3.30	2.05	1.86	1.40	1.80	20	1.80	5.60	2.30	1.96	1.61	1.80	.....
6	.....	2.80	3.20	2.10	1.76	1.45	1.85	21	1.70	5.20	2.25	1.86	1.61	1.80	.....
7	.....	3.50	3.10	2.00	1.81	1.45	1.90	22	1.70	5.00	2.20	1.76	1.56	1.90	.....
8	.....	3.50	3.00	2.00	1.86	1.45	2.10	23	1.70	4.80	2.20	1.96	1.56	1.90	.....
9	.....	4.80	3.00	2.00	1.76	1.45	2.15	24	1.70	4.60	2.15	2.11	1.56	1.90	.....
10	.....	5.40	2.90	2.00	1.76	1.50	2.15	25	1.70	4.50	2.10	2.11	1.61	1.85	.....
11	.....	6.50	2.80	1.96	1.76	1.50	2.10	26	2.50	4.30	2.00	2.16	1.61	1.85	.....
12	.....	8.20	2.50	1.86	1.76	1.55	2.05	27	2.80	4.20	2.00	1.96	1.61	1.80	.....
13	2.00	9.50	2.50	1.76	1.66	1.60	2.00	28	2.60	4.10	2.00	1.91	1.66	1.80	.....
14	1.95	10.50	2.50	1.66	1.56	1.65	2.00	29	2.50	4.00	2.00	1.76	1.66	1.80	.....
15	1.95	10.80	2.50	1.51	1.56	1.80	2.00	30	2.30	3.90	1.95	1.76	1.66	1.80	.....
								31	2.20	.....	1.90	1.36	.....	1.80	.....

Rating table for Milk River at Hinsdale, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	29	2.50	295	3.70	830	4.80	1,525
1.40	33	2.60	330	3.80	885	4.90	1,585
1.50	40	2.70	370	3.90	940	5.00	1,645
1.60	50	2.80	410	4.00	1,000	5.20	1,805
1.70	65	2.90	450	4.10	1,060	5.40	1,945
1.80	85	3.00	490	4.20	1,120	5.60	2,095
1.90	110	3.10	535	4.30	1,185	5.80	2,245
2.00	135	3.20	580	4.40	1,250	6.00	2,395
2.10	165	3.30	625	4.50	1,315	6.20	2,545
2.20	195	3.40	675	4.60	1,385	6.40	2,695
2.30	225	3.50	725	4.70	1,455	6.60	2,850
2.40	260	3.60	775				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on twenty-one discharge measurements made during 1908–9 and is well defined between gage heights 1.6 feet and 5.0 feet. Above gage height 5.0 feet it is fairly well defined. Above gage height 6.5 feet the rating curve is a tangent, the difference being 80 per tenth.

Monthly discharge of Milk River at Hinsdale, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 13–31	410	65	157	5,920	A.
June	6,210	110	1,960	117,000	A.
July	885	110	348	21,400	A.
August	183	31	114	7,010	A.
September	213	46	71.9	4,280	B.
October	110	29	66.9	4,110	B.
November 1–18	180	85	133	4,750	A.
The period	.....	.....	.....	164,000	

WEST FORK OF MILK RIVER AT CHINOOK, MONT.

West Fork of Milk River rises in the southeastern part of the Province of Alberta, Canada, flows southeastward, and enters Milk River near Chinook, Mont.

The gaging station, which is located about 1 mile east of Chinook, was established March 6, 1906, to obtain data for use in connection with irrigation projects in Milk River Valley. West Fork ditch diverts water from West Fork about 4 miles north of Chinook to irrigate land in Milk River Valley. The first diversion was made in 1898 to serve about 75 acres, but later the ditch was extended to irrigate, it is claimed, several hundred acres.

The original gage was an inclined staff located 170 feet above the bridge. On July 1, 1907, the station was moved to the Rainholt ranch, 2 miles upstream, where it remained until April 16, 1908, when it was moved back to the bridge at the same datum as the old gage. On July 9, 1908, it was again moved to the Rainholt ranch, where it still remains. These changes were made because it was impossible to make measurements from the bridge and also because the water from the Fort Belknap canal was at times emptied into the stream above the gage at the bridge. There was no flow after June 26, 1908, and very little at any time during the year.

Results at this station are only fair. The gage heights during high-water periods were affected by back water from Milk River. The stream often goes dry in the autumn and winter months.

Discharge measurements of West Fork of Milk River at Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	Follansbee and Pierson	42	208	6.64	214
April 11	J. B. Pierson	66	587	12.73	734
April 15	do	80	866	16.45	1,410
April 20	do	71	695	14.50	1,180
April 24	Follansbee and Pierson				[a] 335
May 3	J. B. Pierson	43	270	7.36	306
May 13	do	43	274	7.38	290
May 27	do	33	164	4.71	115
June 15	do	32	113	3.20	18.2
June 24	do	45	282	7.55	300
June 25	do	33	154	4.40	94
June 26	Follansbee and Pierson	33	28.8	.92	33.1
July 6	J. B. Pierson	20	11.6	.51	12.2
July 16	do	16	7.2	.36	6.8
July 20	do	16	6.1	.32	5.3
July 29	do	12	3.9	.19	1.6
August 19	do	2	.2	.16	.15
August 26	do	.5		.06	.05
1908.					
May 5	A. F. Huch	12	7.36	[b] .42	4.1
May 26	do		.35	3.06	[c] .26
June 7	do			3.3	[c] .25

[a] Overflow. The gage at the regular station read 16.5 feet.
[b] Old gage read 3.28 feet.
[c] Discharge estimated.

NOTE.—From June 26, 1907, to May 5, 1908, the gage heights refer to a new gage placed 2 miles above the old one. The measurements were made by wading at various sections near the gage.

Daily gage height, in feet, of West Fork of Milk River at Chinook, Mont., for 1907 and 1908.

[Carrie M. Prosser and Agnes Prosser, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1907.							1907.						
1		3.25	5.55	4.00	0.95	0.16	16		16.70	6.40	3.15	0.38	
2		4.25	5.60	3.90	.85	.15	17		16.45	6.15	3.10	.35	
3		4.60	6.70	3.70	.69	.14	18		16.45	5.65	3.10	.35	
4		4.25	6.55	3.60	.68	.10	19		15.05	5.85	3.15	.35	
5		5.05	5.95	3.60	.58	.10	20		14.35	6.45	3.25	.35	
6		7.15	5.75	3.60	.52	.10	21		14.90	6.15	3.40	.30	
7		6.90	5.40	3.60	.48	.09	22		16.70	5.60	3.45	.29	
8		5.50	5.95	3.55	.42	.08	23	3.70	16.90	5.60	3.65	.22	
9		10.10	5.90	3.50	.45	.08	24	3.75	16.30	5.45	6.60	.20	
10		11.10	5.70	3.35	.40	.06	25	3.65	13.05	5.55	4.50	.20	
11		12.80	6.85	3.45	.40		26	3.50	10.65	5.00	4.50	.20	
12		11.65	8.35	3.35	.39		27	3.35	8.80	4.75	3.70	.20	
13		12.65	7.65	3.25	.39		28	3.25	7.25	4.50	3.40	.20	
14		15.40	6.30	3.20	.40		29	3.20	7.05	4.35	3.20	.20	
15		16.55	6.45	3.20	.40		30	3.20	6.25	4.25	2.85	.18	
							31	3.20		4.10		.18	

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1908.				1908.				1908.			
1		3.75	3.6	11		3.1	7.05	21	4.4	3.3	3.6
2		3.35	3.55	12		3.1	4.9	22	4.15	3.65	3.6
3		3.3	3.7	13		3.1	3.8	23	3.85	3.35	3.65
4		3.3	3.8	14		3.1	3.55	24	3.8	3.3	3.7
5		3.3	3.85	15		3.1	3.25	25	3.65	3.25	3.8
6		3.55	3.7	16	3.5	3.4	3.1	26	3.6	3.25	3.35
7		3.3	3.3	17	4.3	3.35	3.2	27	3.7	3.05	2.9
8		3.15	3.1	18	4.85	3.3	3.55	28	3.6	2.9	2.9
9		3.1	3.85	19	4.55	3.5	3.6	29	3.6	3.0	2.95
10		3.05	5.25	20	4.45	3.5	3.6	30	3.6	3.0	3.0
								31		3.6	

NOTE.—Gage heights July 1–August 10, 1907, refer to new gage, and are not comparable with the old one. Gage heights for 1908 refer to old gage.
Gage heights June 9–13 (about), 1908, affected by backwater due to floods on Milk River.
Practically no flow January 1–March 22 and August 11–December 31, 1907.
There was no flow after June 26, 1908, and very little at any time during the year.

Daily discharge, in second-feet, of West Fork of Milk River at Chinook, Mont., for 1907.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1		19	175	68	35	1	16	1,830	220	20	7		
2		64	178	62	29	1	17	1,720	204	17	7		
3		82	251	51	21	1	18	1,720	174	17	7		
4		64	240	45	20	.5	19	1,220	184	20	7		
5		106	198	45	16	.5	20	1,160	224	26	7		
6		240	186	45	13	.5	21	1,250	204	34	4		
7		230	165	45	11	.5	22	1,830	168	37	4		
8		135	190	43	9	.5	23	25 2,050	168	48	2		
9		462	187	39	10	.5	24	25 1,700	160	236	2		
10		560	174	31	8	0	25	25 960	165	98	2		
11		745	250	37	8		26	29 630	134	98	2		
12		625	370	31	8		27	23 430	119	50	2		
13		770	314	26	8		28	19 295	99	33	2		
14		1,210	212	22	8		29	17 278	89	23	2		
15		1,700	223	22	8		30	17 220	84	15	2		
							31	17	74		2		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of West Fork of Milk River at Chinook, Mont., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 23–31	29	17	21.9	391	C.
April	2,050	19	810	48,200	B.
May	370	74	187	11,500	A.
June	236	15	46.1	2,740	B.
July	35	2	8.8	541	B.
August	1	0	.19	12	D.

NORTH FORK OF MILK RIVER NEAR CHINOOK, MONT.

This station, which is located about 4½ miles north of Chinook, Mont., and about 7 miles above the junction of North Fork with Milk River, was established April 22, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used on this stream. Three canals which divert an aggregate of about 20 second-feet take out above the station. Several small pumping plants which supply water for irrigating the bottom land along the river valley also operate above the station. Below the station the Matheson and Cook canals divert water for irrigating land in Milk River valley near the mouth of North Fork. The aggregate appropriation of these canals is 78 second-feet.

The results at this station may be considered reliable as a fair rating curve has been obtained. Ice during the winter months makes gage readings impracticable. The datum of the gage has remained the same since the station was established in 1905.

The greater part of the run-off occurs during floods caused by heavy rains in the spring and early summer. The stream often goes dry in the fall.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	Robert Follansbee	63	282	4.54	802
April 11	J. B. Pierson	79	588	8.17	2,180
April 12	....do	73	500	6.55	1,480
April 15	....do	78	561	8.35	[a] 3,090
April 20	....do	66	329	4.88	986
April 24	....do	71	463	6.38	1,490
April 27	....do	65	358	4.90	997
May 3	....do	62	271	4.14	697
May 13	....do	62	182	3.37	463
May 27	....do	57	123	2.24	233
June 13	....do	56	61	1.29	94
June 21 [b]	....do	56	62	1.34	83
June 25	....do	56	76	1.63	133
July 6 [b]	....do	62	46	1.10	54
July 16	....do	56	67	1.41	87
July 29 [b]	....do	25	18.8	.78	23.5
August 17 [b]	....do	8	5.1	.45	5.3
August 19 [b]	Follansbee and Pierson	8	4.5	.42	4.0
August 26 [b]	J. B. Pierson	4	2.5	.31	2.2
October 19 [b]	Follansbee and Stewart	24	20.2	.64	12.5

[a] Measurement doubtful. [b] Made by wading.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1907 and 1908—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6[a]	Stewart and Huch	56	50	1.57	30.4
April 22	A. F. Huch	56	62.8	1.35	62.2
May 5	do	56	45.3	.96	46.2
May 26[b]	do	24	11.1	.51	9.5
June 4[b]	do	21	12.8	.50	13.8
July 7	do		.15	.20	[c] 17

[a] Measurement made through the ice. Gage height top of ice 1.6 feet. Gage height under surface of ice 1.2 feet.

[b] Made by wading.

[c] Estimated.

Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1907 and 1908.

[Mrs. R. B. Snedecker, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		1.65	2.85	1.68	1.44	0.69	0.45	0.66	0.70	0.77
2		1.65	4.12	1.62	1.42	.66	.39	.66	.70	.79
3		1.65	4.40	1.60	1.36	.63	.38	.65	.70	.79
4		1.68	3.48	1.55	1.28	.61	.35	.63	.70	.80
5		1.70	2.80	1.52	1.20	.58	.31	.62	.70	.80
6		4.05	2.88	1.48	1.16	.57	.29	.61	.70	.81
7		5.15	2.85	1.45	1.09	.56	.29	.58	.70	.81
8		[a] 4.50	2.68	1.42	.98	.53	.28	.57	.70	.81
9		6.45	2.82	1.42	1.17	.51	.27	.57	.70	
10		8.42	2.92	1.40	1.06	.49	.25	.57	.78	
11		7.75	2.72	1.38	1.00	.48	.24	.59	.90	
12		6.38	3.10	1.38	.98	.46	.27	.59	.90	
13		6.22	3.30	1.55	2.70	.43	.39	.61	.89	
14		7.20	2.72	2.25	2.53	.42	.40	.62	.86	
15		8.25	2.48	1.75	2.38	.42	.43	.62	.82	
16		7.28	2.35	2.52	1.44	.43	.44	.62	.80	
17		5.30	2.28	2.18	1.40	.44	.45	.62	.80	
18		5.90	2.22	2.02	1.26	.45	.47	.66	.80	
19		5.28	2.18	1.82	1.07	.44	.49	.66	.80	
20		4.98	2.20	1.60	1.07	.42	.50	.66	.82	
21	2.12	7.05	2.10	1.38	1.05	.39	.66	.66	.81	
22	1.50	8.45	2.10	1.40	.99	.36	.72	.67	.80	
23	2.25	7.72	2.10	1.68	.96	.34	.73	.68	.80	
24	1.92	6.42	2.10	2.25	.93	.32	.72	.68	.79	
25	1.72	5.98	2.82	1.65	.91	.30	.70	.69	.77	
26	1.65	5.25	2.80	1.55	.88	.30	.69	.69	.74	
27	1.65	4.70	2.20	1.50	.87	.29	.64	.69	.72	
28	1.65	3.42	2.00	1.50	.85	.26	.63	.70	.72	
29	1.65	2.72	1.88	1.48	.81	.25	.64	.70	.72	
30	1.65	2.45	1.78	1.48	.78	.42	.64	.70	.74	
31	1.65		1.68		.75	.50		.70		
1908.										
1		1.60	1.32	.42	.24					.84
2		1.60	1.54	.45	.18					.84
3		1.65	1.45	.47	.14					.84
4		1.64	1.06	.51	.12					.84
5		1.61	.98	.60	.11					.84
6		1.55	.96	.60	.10					.84
7		1.20	.93	.62	.12					.84
8		1.18	.89	.61	.14					.84
9		1.28	.86	.60	.11					.84
10		1.52	.81	.56	.10					.84
11		1.10	.80	.54	.10					.84
12	1.65	1.05	.80	.50	.08					.84
13	1.68	1.10	.80	.52	.10					.84
14	1.71	1.40	.78	.62	.10					.84
15	1.70	1.72	.74	.68	.08					.84

[a] Maximum gage height April 8, 1907, was 10.0 feet.

Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
16	1.65	1.75	0.71	0.69	0.06	.....	.....	.....	.....	0.84
17	1.65	2.12	.63	.62	.....	.....	.....	.....	.....	.84
18	1.60	2.08	.63	.62	.....	.....	.....	.....	.....	.84
19	1.60	1.85	.62	.58	.....	.....	.....	.....	.....	.84
20	1.58	1.68	.61	.52	.....	.....	.....	.....	0.69	.84
21	1.58	1.48	.60	.44	.....	.....	.....	.....	.80	.84
22	1.60	1.34	.60	.40	.....	.....	.....	.....	.84	.84
23	1.64	1.32	.60	.39	.....	.....	.....	.....	.70	.84
24	1.68	1.31	.59	.38	.....	.....	.....	.....	.50	.84
25	1.62	1.26	.58	.36	.....	.....	.....	.....	.56	.84
26	1.50	1.21	.52	.34	.....	.....	.....	.....	.70	.84
27	1.50	1.20	.51	.31	.....	.....	.....	.....	1.15	.84
28	1.50	1.16	.49	.28	.....	.....	.....	.....	1.36	.84
29	1.52	1.15	.48	.26	.....	.....	.....	.....	.46	.84
30	1.59	1.15	.45	.25	.....	.....	.....	.....	1.50	.84
31	1.60	.....	.43	.....	.....	.....	.....	.....	.....	.84

NOTE.—Ice conditions January 1 to April 6, 1907; during a part of this period the river was frozen to the bottom at the gage, but there was considerable flow at the far side of the channel. Slight ice conditions in November, 1907. River frozen December 9, 1907, to April 10, 1908, and December 1 to 31, 1908.
From July 8 to November 20, 1908, there was practically no flow, water standing in pools.

Rating table for North Fork of Milk River near Chinook, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	0	1.60	116	3.00	400	4.80	912
.30	2	1.70	133	3.10	424	5.00	980
.40	4	1.80	151	3.20	448	5.20	1,052
.50	7	1.90	170	3.30	472	5.40	1,124
.60	11	2.00	190	3.40	496	5.60	1,198
.70	17	2.10	210	3.50	522	5.80	1,274
.80	24	2.20	230	3.60	548	6.00	1,350
.90	32	2.30	250	3.70	574	6.20	1,430
1.00	41	2.40	270	3.80	602	6.40	1,510
1.10	51	2.50	291	3.90	630	6.60	1,590
1.20	62	2.60	312	4.00	658	6.80	1,670
1.30	74	2.70	333	4.20	718	7.00	1,750
1.40	87	2.80	355	4.40	780	8.00	2,170
1.50	101	2.90	377	4.60	844	9.00	2,606

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nineteen discharge measurements made during 1907, and is well defined below gage height 4.5 feet. Above gage height 4.5 feet the rating is fairly well defined.

Daily discharge, in second-feet, of North Fork of Milk River near Chinook, Mont., for 1908.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	74	9	1	16	118	22	22	.....
2	.....	106	10	1	17	190	17	17	.....
3	.....	95	12	1	18	182	17	17	.....
4	.....	56	14	1	19	137	16	15	.....
5	.....	48	19	1	20	106	15	12	.....
6	.....	46	18	1	21	77	15	9	.....
7	.....	42	19	1	22	62	15	7	.....
8	.....	39	19	1	23	64	15	6	.....
9	.....	35	18	.....	24	63	14	6	.....
10	.....	30	16	.....	25	58	14	5	.....
11	38	29	14	.....	26	57	10	4	.....
12	33	29	12	.....	27	56	10	3	.....
13	38	29	13	.....	28	52	10	2	.....
14	68	28	18	.....	29	56	9	2	.....
15	111	25	22	.....	30	56	9	1	.....
					31	.....	9	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Fork of Milk River near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 21–31	240	101	146	3,190	A.
April	2,360	124	1,150	68,400	A.
May	780	130	332	20,400	A.
June	295	84	128	7,620	A.
July	333	20	74.8	4,600	B.
August	16	1	6.2	381	C.
September	19	1	7.7	458	C.
October	17	10	13.7	842	B.
November	26	17	20.1	1,200	C.
December 1–8	25	22	23.9	379	C.
The period	.....	.....	.....	107,000	
1908.					
March	.....	.....	[a] 30.0	1,840	D.
April	190	30	64.1	3,810	C.
May	106	9	29.9	1,840	A.
June	19	1	12.0	714	C.
November, 20–30	.....	.....	[a] 15.0	328	D.
December	.....	.....	[a] 10.0	615	D.

[a] Estimated.

NOTE.—Practically no flow in July, August, September, and October, 1908.

BEAVER CREEK NEAR ASHFIELD, MONT.

Beaver Creek rises in the little Rocky Mountains, flows northeastward, and enters Milk River near Hinsdale, Mont.

The gaging station, which was established December 31, 1903, to obtain data for use in connection with irrigation projects in Milk River valley, is located at Craig's ranch, about 18 miles from Malta and 3 miles south of Ashfield, Mont., the nearest post-office. It was discontinued from August 30, 1906, to May 2, 1908.

The only diversion is that for the irrigation of land bordering the stream. The water is diverted by small ditches leading from the stream and by small pumping plants near the banks.

The entire run-off from this area does not pass the station. At medium and high stages a second channel, known as Beaver Creek overflow, leaves the stream above the station, follows a depression to the west of the main channel, and reenters at a point some distance below the gage. Records are kept of the flow of this channel.

The gage was first established at bridge No. 455 of the Great Northern Railway, one-half mile west of Ashfield, Mont. It was moved to its present location 2½ miles upstream December 31, 1903. The stream carries but little water except at the times of the spring floods or heavy rains. During the summer months the channel is obstructed by a dense growth of weeds and willows, which have to be cleared out occasionally, thus making it a difficult matter to procure a permanent rating. The results therefore are only fair. The gage heights for 1908 are too unreliable to publish.

Discharge measurements of Beaver Creek near Ashfield, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 2	A. F. Huch	18	6.8	0.35	1.8
May 12	Stewart and Huch	.....	.6	.14	[a] .4
June 8	A. F. Huch	.....	.....	.00	[a] .01

[a] Float measurement.

BEAVER CREEK OVERFLOW NEAR BOWDOIN, MONT.

This station which was established June 29, 1903, discontinued August 30, 1906, and reestablished May 2, 1908, is located at John Turmell's ranch, 14 miles from Malta, Mont.

The flow of this channel must be added to that of the Beaver Creek station to get the total flow from the drainage area. The channel was practically without flow during the season of 1908 as the water was standing in pools.

Daily gage height, in feet, of Beaver Creek overflow near Bowdoin, Mont., for 1908.

[John Turnell, observer.]

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	.....	2.4	1.6	1.2	16	2.9	2.2	1.4	1.0
2	.....	2.4	1.6	1.2	17	2.8	2.1	1.3	1.0
3	3.25	2.4	1.6	1.1	18	2.8	2.1	1.3	1.0
4	3.25	2.4	1.6	1.1	19	2.8	2.1	1.3	1.0
5	3.25	2.4	1.5	1.1	20	2.7	2.1	1.3	1.0
6	3.15	2.4	1.5	1.1	21	2.7	2.0	1.3	1.0
7	3.15	2.3	1.5	1.1	22	2.6	2.0	1.3	1.0
8	3.15	2.3	1.5	1.1	23	2.6	1.9	1.3	1.0
9	3.05	2.3	1.5	1.1	24	2.6	1.9	1.2	.9
10	3.05	2.3	1.4	1.1	25	2.6	1.8	1.2	.9
11	2.95	2.3	1.4	1.0	26	2.5	1.8	1.2	.9
12	2.95	2.3	1.4	1.0	27	2.5	1.7	1.2	.9
13	3.0	2.2	1.4	1.0	28	2.5	1.7	1.2	.8
14	3.0	2.2	1.4	1.0	29	2.5	1.7	1.2	.8
15	2.9	2.2	1.4	1.0	30	2.4	1.7	1.2	.8
					31	.....	.....	1.2	.8

NOTE.—Practically no flow during the above period, water standing in pools.

ROCK CREEK NEAR HINSDALE, MONT.

This station, which was established March 28, 1906, to obtain data for use in connection with the Milk River irrigation project, was discontinued September 30, 1907. It was located just below the diversion dam for Rock Creek canal and 7 miles north of Hinsdale.

Willow Creek, the only important tributary of Rock Creek, drains the country to the east and enters a few miles above the station. The most important diversion is the Rock Creek canal, which takes out water a few hundred feet above the station.

Measurements were made from a cable, but in low water they were made by wading. During the last part of the year the creek goes dry and the water stands in pools. Records obtained were very good.

Discharge measurements of Rock Creek near Hinsdale, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16 [a]	J. B. Pierson	77	531	7.26	1,310
April 23 [a]	do	111	1,070	13.07	3,670
April 25 [b]	do	75	519	6.93	1,390
May 21 [c]	do	60	375	4.83	664
May 28 [d]	do	53	283	3.35	219
June 17 [a]	do	53	266	3.10	217
July 9 [a]	do	53	206	1.84	30.6
July 31 [e]	do	.....	.....	1.36	1.0
August 21	do	.....	.....	.....	.0
October 21 [e]	Robert Follansbee	.....	.....	1.40	1.5

[a] Canal dry.
[b] Large flow in canal; not measured.
[c] Canal flow = 326 second-feet.
[d] Canal flow = 284 second-feet.
[e] Estimated.

NOTE.—Just after the measurement of April 23, 1907, the head gates of the canal were washed out and during the remainder of the high-water period water flowed through the canal, except for short intervals when it was stopped temporarily.

Daily gage height, in feet, of Rock Creek near Hinsdale, Mont., for 1907.

[F. E. Halbert, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.5	6.4	2.8	2.2	1.3	3.1	16	7.25	4.8	4.6	1.7	1.3	1.3
2	4.4	6.3	2.4	2.2	1.3	2.9	17	5.7	4.7	3.9	1.5	1.3	1.3
3	5.1	6.3	2.3	2.2	1.3	2.9	18	5.0	4.8	3.2	1.5	1.3	1.3
4	4.3	6.2	3.2	2.2	1.3	2.8	19	5.0	4.8	3.7	1.5	1.4	1.3
5	5.9	6.0	2.8	2.2	1.3	2.2	20	7.5	4.8	2.5	1.4	1.4	1.3
6	6.3	6.0	2.6	2.2	1.3	1.5	21	9.7	4.8	2.4	1.4	1.4	1.3
7	9.6	5.9	2.5	2.2	1.3	1.4	22	11.95	5.0	2.3	1.4	1.4	1.3
8	8.7	5.8	2.4	2.2	1.3	1.4	23	11.2	5.4	2.3	1.4	1.4	1.3
9	9.0	5.8	2.4	2.1	1.3	1.4	24	10.4	6.1	2.3	1.4	1.4	1.3
10	12.4	5.6	2.4	2.1	1.3	1.4	25	8.7	7.7	2.3	1.4	1.4	1.3
11	17.0	5.5	2.4	2.0	1.3	1.4	26	7.3	6.2	2.3	1.4	1.4	1.3
12	17.0	5.5	2.4	1.9	1.3	1.4	27	7.3	5.7	2.3	1.4	1.4	1.3
13	12.0	5.3	2.3	1.9	1.3	1.4	28	6.9	5.3	2.3	1.4	1.4	1.3
14	12.5	5.4	2.3	1.8	1.3	1.4	29	6.7	4.9	2.3	1.3	1.4	1.2
15	9.5	5.0	4.8	1.8	1.3	1.4	30	6.5	4.4	2.2	1.3	1.4	1.2
							31	.....	3.1	.....	1.3	2.4	.....

NOTE.—Practically no flow after September 28, 1907. Ice conditions January 1 to March 31, 1907 (approximately).

Rating table for Rock Creek near Hinsdale, Mont., for April 1, 1906, to September 30, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	0	3.00	182	4.80	630	8.20	1,695
1.30	.5	3.10	201	4.90	659	8.40	1,763
1.40	2	3.20	221	5.00	688	8.60	1,831
1.50	7	3.30	242	5.20	746	8.80	1,901
1.60	13	3.40	264	5.40	805	9.00	1,971
1.70	20	3.50	287	5.60	865	10.00	2,343
1.80	27	3.60	311	5.80	925	11.00	2,750
1.90	35	3.70	335	6.00	985	12.00	3,180
2.00	44	3.80	360	6.20	1,047	13.00	3,620
2.10	54	3.90	385	6.40	1,109	14.00	4,080
2.20	65	4.00	411	6.60	1,171	15.00	4,550
2.30	77	4.10	437	6.80	1,235	16.00	5,030
2.40	89	4.20	463	7.00	1,299	17.00	5,520
2.50	102	4.30	490	7.20	1,363	18.00	6,020
2.60	116	4.40	517	7.40	1,428	18.40	6,220
2.70	131	4.50	545	7.60	1,494		
2.80	147	4.60	573	7.80	1,560		
2.90	164	4.70	601	8.00	1,627		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on ten discharge measurements made during 1907 and one in 1906, and is fairly well defined between gage heights 1.2 feet and 14.0 feet.

Monthly discharge of Rock Creek near Hinsdale, Mont., for 1906 and 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1906.					
April	16	0	0.83	49	D.
May	3,080	0	225	13,800	C.
June, 27 days	6,220	2	807	43,200	B.
July 1–12	77	0	38.6	916	D.
The period				58,000	
1907.					
April	5,520	102	1,900	113,000	B.
May	1,530	201	832	51,200	A.
June	630	65	150	8,930	B.
July	65	.5	27.6	1,700	D.
August	89	.5	3.49	242	D.
September	201	.0	25.7	1,530	D.
The period				177,000	

NOTE.—No record of discharge for missing days in June, 1906, because of high water. Maximum for month as given is only approximate.
Values of accuracy as given apply only to the water flowing in the creek and are exclusive of the canal.

PORCUPINE CREEK AT NASHUA, MONT.

Porcupine Creek rises in the northern part of Valley County, Mont., flows southward, forming the west boundary of the Fort Peck Indian Reservation, and enters Milk River at Nashua, a point about 5 miles from the junction of Milk River with the Missouri.

The drainage area comprises a strip of rolling prairie about 40 miles long and extending but a short distance back from the narrow valley formed by the stream. Forestation is lacking, except a growth of willows and cottonwoods along the banks of the stream.

The greater part of the run-off comes from the melting snow in the early spring and from heavy rains during the summer. In the late summer and winter the stream is dry. The annual rainfall is about 13 inches. The water of this stream is neither diverted nor stored.

The only gaging station is at the road crossing at Nashua. It was established July 11, 1908, to obtain data for an irrigation project under construction by the United States Reclamation Service for the Fort Peck Indians.

The following discharge measurement was made at this station on July 12, 1908:

Gage height, 1.70 feet; discharge estimated as 0.1 second-foot.

Daily gage height, in feet, of Porcupine Creek at Nashua, Mont., for 1908.

[Wm. H. Todd, observer.]

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1		0.6	11	1.7		21	1.1	
2		.5	12	1.6		22	1.1	
3		.5	13	1.6		23	1.0	
4		.5	14	1.3		24	.7	
5		.5	15	1.3		25	.9	
6		.4	16	1.9		26	.8	
7		.4	17	1.4		27	.7	
8		.3	18	1.3		28	.7	
9			19	1.2		29	.7	
10			20	1.2		30	.7	
						31	.6	

NOTE.—Except for July 16 there was practically no running water after July 11.

PRIVATE CANALS IN MILK RIVER VALLEY.

DESCRIPTION.

Since 1905 a number of stations have been maintained on private canals in Milk River valley for the purpose of ascertaining the extent of private water rights. With the exception of Rock Creek canal, which is near Hinsdale in Valley County, these canals are located in Chouteau County and are used to irrigate lands in the vicinity of Harlem and Chinook.

The canals are all built on small grades and in soil which is easily eroded. In many of them silt has been deposited and nearly all of them contain a growth of weeds and moss. At low stages the water is uniformly sluggish. In order to divert water into the laterals, checks are erected in the main canals, and these checks often produce back-water effects for long distances above. They were put up under a great variety of conditions, and as a result velocities are found to differ widely at the same gage height during the season. In order to establish the correct relation between gage height and discharge it is necessary to make several rating curves for the same canal station. Frequent discharge measurements are necessary to obtain reliable results.

The following gaging stations have been here maintained:

Paradise Valley canal near Chinook, Mont., 1903–1908.
Cook canal near Chinook, Mont., 1905–1908.
Matheson canal near Chinook Mont., 1905–1908.
Harlem canal near Zurick, Mont., 1903–1908.
Agency ditch near Harlem, Mont., 1905–1908.
Fort Belknap canal near Chinook, Mont., 1903–1908.
Winter Anderson canal near Chinook, Mont., 1906–1908.
Rock Creek canal near Hinsdale, Mont., 1905–1907.

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

This station, which was established in June, 1903, is located near the head-gate at Rudolph Friede's ranch and is reached by driving about 7 miles along the south river road from Chinook.

Discharge measurements of Paradise Valley canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	J. B. Pierson	17	16.0	1.55	7.7
June 3	....do	.....	.....	.68	.0
June 19	....do	.....	.....	1.16	.0
July 8	....do	9	3.6	1.49	2.6
July 17	....do	8	2.7	1.26	1.3
July 30	....do	9	2.4	1.09	1.4
August 17	....do	14	13.1	1.60	7.0
August 24	....do	12	11.4	1.58	6.1
September 10	....do	6	3.5	1.04	1.0
September 27	Robert Follansbee	12	7.5	1.31	2.1
1908.					
April 7	Stewart and Huch	18	12.6	1.41	5.3
April 27	A. F. Huch	27	29.9	1.89	22.6
May 6	....do	26	21.8	1.50	10.8
May 15	Stewart and Huch	19	15.8	1.28	6.2
May 25	A. F. Huch	22	22.1	1.51	7.0
June 2	....do	18	4.2	1.41	[a] 4.2
June 12 [b]	....do	7	1.3	1.00	1.0
June 24 [b]	....do	7	3.8	1.20	1.7
July 6 [b]	....do	9	8.5	1.60	5.3
July 17 [b]	....do	11.5	9.8	1.80	7.1
August 6	....do	11	10.9	1.90	6.7

[a] Measurement affected by growth in canal.

[b] Made by wading.

Daily gage height, in feet, of Paradise Valley canal near Chinook, Mont., for 1907 and 1908.

[Rudolph Friede, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1907.							1908.						
1	.....	0.71	.....	1.45	1.36	1.40	1	.....	1.61	1.61	1.83	1.80	1.19
2	.....	.66	1.78	1.41	1.47	1.31	2	.....	1.58	1.44	1.70	1.66	1.21
3	.....	.68	1.94	1.55	1.51	1.29	3	.....	1.68	1.45	1.71	1.52	1.21
4	.....	.60	1.81	1.50	1.37	1.38	4	.....	1.44	1.29	1.78	1.33	1.18
5	.....	.55	1.52	1.44	.98	1.30	5	1.50	1.51	1.38	1.73	1.74	1.12
6	.....	.54	1.48	1.35	.95	1.33	6	1.50	1.55	1.20	1.60	1.92	1.08
7	.....	.79	1.42	1.32	.90	1.30	7	1.40	1.50	1.19	2.49	1.86	1.02
8	.....	1.16	1.49	1.15	1.08	1.32	8	1.60	1.49	1.11	1.81	1.83	.....
9	1.00	1.26	1.43	1.40	1.02	1.31	9	1.05	1.55	1.10	1.76	1.71	.....
10	1.10	1.36	1.38	1.74	1.05	1.33	10	.98	1.61	1.10	1.72	1.63	.....
11	1.32	1.65	1.40	1.81	1.03	1.32	11	1.18	1.61	1.10	1.81	1.93	.....
12	1.38	1.61	1.33	1.76	1.04	1.30	12	1.18	1.59	1.04	1.81	2.00	.....
13	1.47	1.63	1.28	1.79	1.07	1.30	13	1.00	1.57	.98	1.82	1.89	.....
14	1.54	2.04	1.62	1.78	1.08	1.33	14	1.48	1.64	.97	1.83	1.97	.....
15	1.45	1.56	1.31	1.72	1.08	1.29	15	2.05	1.26	.97	1.82	1.88	.....
16	1.31	1.24	1.22	1.59	1.10	1.29	16	2.00	1.27	.94	1.82	1.87	.....
17	1.22	1.22	1.21	1.59	1.09	1.29	17	1.82	1.30	.93	1.82	1.86	.....
18	1.23	1.12	1.17	1.57	1.08	1.28	18	1.90	1.27	.93	1.75	1.90	.....
19	1.11	1.16	1.08	1.52	1.28	1.31	19	1.84	1.31	.90	1.85	1.90	.....
20	1.07	.93	1.03	1.48	1.16	1.29	20	1.82	1.30	1.61	1.88	1.89	.....
21	1.08	.92	.98	1.47	1.11	1.28	21	1.80	1.30	1.45	1.90	1.86	.....
22	1.31	1.62	1.01	1.49	1.41	1.18	22	1.75	1.50	1.40	1.88	1.81	.....
23	1.37	2.10	.88	1.42	1.33	1.27	23	1.84	1.41	1.27	1.89	1.87	.....
24	1.31	1.29	.80	1.59	1.16	1.26	24	1.82	1.53	1.20	1.82	1.70	.....
25	1.50	1.10	.88	1.63	1.70	1.29	25	1.85	1.51	1.13	1.81	1.44	.....
26	1.52	.98	.61	1.50	1.75	1.31	26	1.82	1.47	1.00	1.89	1.33	.....
27	1.24	.78	.50	1.36	1.28	1.33	27	1.85	1.49	1.19	1.78	1.28	.....
28	1.10	.74	1.28	1.25	1.29	1.32	28	1.88	1.51	1.00	1.73	1.28	.....
29	.92	.73	1.23	1.12	1.37	1.31	29	1.88	1.57	.98	1.89	1.30	.....
30	.81	.68	1.10	1.11	1.19	1.30	30	1.63	1.50	1.99	1.78	1.21	.....
31	.75	.....	1.30	1.39	.....	1.27	31	.....	1.49	.....	1.64	1 19	.....

Monthly discharge of Paradise Valley canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
May 9–31	7.7	0.3	4.00	182
June	12.2	.0	1.54	92
July	9.1	.0	1.89	116
August	9.7	1.5	5.38	331
September	7.2	.4	2.18	130
October	2.9	1.2	2.07	127
1908.				
April 5–30	22	1	13.9	717
May	16	5	8.97	552
June	14	.0	2.20	131
July	22	5	7.71	474
August	8	.0	5.03	309

NOTE.—The estimates are only approximate, owing to great and irregular fluctuation of daily stages.

COOK CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a small wooden highway bridge on the road running parallel to the Great Northern Railway, about 3 miles east of Chinook.

Discharge measurements of Cook canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 24	J. B. Pierson	.....	.....	2.40	0.0
May 10	do	.....	.....	2.63	1.0
May 25	do	.....	.....	.....	.0
June 4	do	.....	.....	.....	.0
July 6	do	9	4.5	2.38	3.3
July 29	do	13	12.6	3.05	8.2
August 19	do	.....	.....	2.00	.0
1908.					
April 6	Stewart and Huch	.....	.....	2.20	.....
April 25	A. F. Huch	13.5	28.1	[a] 2.06	12.4
May 4	do	14	37.7	3.51	31.5
May 11	do	15	35.3	3.37	21.2
May 15	Stewart and Huch	14	34.6	3.28	18.5
May 26	A. F. Huch	15	10.8	2.19	[b] 3.7
June 3	do	14	11.6	2.29	[b] 5.0
June 13	do	13	8.55	2.04	[b] 1.5
June 23	do	14	11.6	2.38	[b] 4.1
July 7	do	7.5	4.56	[a] 1.24	[b] 2.5
July 16	do	7	3.23	2.00	[b] .9
Aug. 4	do	8.5	5.40	[a] 1.30	[b] 2.9

[a] Gage probably read 1 foot too low.

[b] Made by wading.

Daily gage height, in feet, of Cook canal near Chinook, Mont., for 1907 and 1908.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1907.						1907.					
1	.....	2.5	3.3	3.2	3.1	16	1.9	2.1	3.3	2.7	2.5
2	.....	2.5	3.3	3.3	3.1	17	2.5	.....	3.3	2.7	2.0
3	.....	2.5	3.2	3.5	3.1	18	3.3	.....	3.3	2.6	2.0
4	.....	2.5	3.5	2.9	3.1	19	3.1	.....	3.4	2.5	2.0
5	.....	2.4	3.5	2.8	3.0	20	3.1	3.1	3.4	2.5	1.9
6	.....	2.4	3.4	2.1	2.9	21	3.6	3.0	3.5	2.7	.....
7	.....	2.4	3.3	2.4	2.8	22	2.8	3.0	3.5	2.7	.....
8	.....	2.4	3.3	2.9	2.7	23	2.4	3.1	2.8	2.9	.....
9	.....	2.4	3.3	2.9	2.6	24	2.4	3.0	3.2	2.9	.....
10	.....	2.6	3.3	2.9	2.6	25	2.5	3.3	3.6	2.9	.....
11	2.7	2.6	3.2	2.8	2.6	26	2.5	3.1	3.2	2.9	.....
12	2.7	2.6	3.2	2.8	2.6	27	2.5	2.8	2.1	2.9	.....
13	2.8	2.1	3.3	2.8	2.6	28	2.5	2.8	2.2	2.9	.....
14	2.2	2.8	3.4	2.8	2.5	29	2.6	3.1	3.3	3.0	.....
15	2.2	2.2	3.3	2.7	.....	30	2.4	3.1	3.4	3.0	.....
						31	.....	3.3	.....	3.0	.....

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1908.						1908.					
1	.....	3.6	2.5	2.8	2.0	16	3.7	3.3	2.0	1.8	3.0
2	.....	3.7	2.3	2.8	2.0	17	3.6	3.3	2.0	1.8	2.9
3	.....	3.5	2.4	2.9	2.0	18	3.8	3.4	2.0	1.8	2.8
4	.....	3.5	2.4	2.8	.....	19	3.4	3.2	2.1	1.9	2.8
5	.....	3.4	2.7	2.6	2.1	20	3.3	3.1	2.0	1.9	2.9
6	.....	3.6	2.7	2.4	2.2	21	3.2	3.0	2.4	2.0	2.8
7	.....	3.4	2.7	2.2	2.2	22	3.4	2.3	2.3	2.0	2.7
8	2.4	3.4	2.8	2.0	2.2	23	3.5	2.4	2.4	2.0	2.7
9	2.9	3.5	2.8	1.9	3.2	24	3.0	2.0	2.3	2.0	2.7
10	2.4	3.4	2.5	1.8	3.2	25	3.0	2.0	2.4	2.0	2.7
11	3.3	3.4	2.4	1.7	3.3	26	3.1	2.3	3.4	2.0	2.7
12	3.4	3.4	2.2	2.4	3.4	27	3.7	2.0	3.4	2.0	2.7
13	3.0	3.4	2.1	2.5	3.5	28	3.7	2.2	3.2	2.1	2.6
14	2.9	3.3	2.1	1.9	3.1	29	3.6	2.7	3.0	2.1	2.6
15	3.1	3.3	2.0	1.8	3.0	30	3.6	2.7	2.9	2.1	2.6
						31	.....	2.0	.....	2.1	2.6

NOTE.—Canal dry after August 20, 1907, and after August 31, 1908.

Monthly discharge of Cook canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet)
	Maximum.	Minimum.	Mean.	
1907.				
July	12.0	1.5	6.58	405
August 1-20	8.6	.5	5.02	199
1908.				
April 8-30	37	2	17.5	798
May	32	2	17.1	1,050
June	28	1	7.30	434
July	13	.0	3.26	200
August	5	.0	1.58	97

NOTE.—These estimates are only approximate, owing to great and irregular fluctuation of daily stages.

MATHESON CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a footbridge 200 feet below the head-gate near the main road, 3½ miles east of Chinook.

Discharge measurements of Matheson canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	Stewart and Huch				0.0
April 25	A. F. Huch	11.0	15.3	3.23	13.9
May 4	do	8.0	6.86	2.16	4.5
May 11	do			1.85	[a]5
May 15	J. E. Stewart	6.4	5.92	2.24	3.7
May 26	A. F. Huch	7.0	9.31	2.58	6.2
June 3	do	6.0	5.60	2.31	[b]2.2
June 13	do	10.0	12.3	3.07	[b]7.8
June 23	do	9.0	12.0	[c]3.00	.6
July 7	do	8.0	6.16	2.37	.9
July 16	do	7.0	5.26	2.18	.6

[a] Estimated.
[b] Measurement affected by growth in canal.
[c] Backwater due to beaver dams.

NOTE.—The station was visited by a hydrographer on May 10 and 25, June 4, July 6 and 27, and August 19, 1907, and each time there was no flow, as the water was standing in pools.

Mean daily gage height, in feet, of Matheson canal near Chinook, Mont., for 1907 and 1908.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1908.						1908.					
1	.....	2.4	2.4	2.6	2.5	16	3.4	2.0	2.1	2.1	2.4
2	.....	2.4	2.3	2.8	2.5	17	3.4	2.2	2.1	2.1	2.3
3	.....	2.0	2.4	2.6	2.5	18	3.5	2.3	2.1	2.0	2.3
4	.....	2.2	2.5	2.5	.....	19	2.9	2.3	2.1	2.0	2.3
5	.....	2.1	2.7	2.5	2.4	20	3.5	2.2	2.1	2.0	2.3
6	.....	1.9	2.8	2.4	2.3	21	3.4	1.9	2.5	1.9	2.3
7	.....	1.8	2.9	2.4	2.1	22	2.5	2.0	1.9	1.9	2.3
8	2.5	1.8	2.9	2.2	2.1	23	2.9	2.1	1.9	1.9	2.3
9	2.9	1.7	2.7	2.1	2.2	24	2.5	2.5	2.5	2.0	2.3
10	3.0	1.9	2.6	2.1	2.2	25	3.2	2.6	2.7	2.1	2.3
11	2.9	1.9	2.3	2.1	2.2	26	3.4	2.6	2.8	2.1	2.2
12	2.7	1.8	2.0	2.1	2.2	27	2.3	2.6	2.8	2.2	2.2
13	2.9	2.1	2.1	2.1	2.2	28	2.0	2.7	2.8	2.2	2.2
14	2.8	1.9	2.0	2.1	2.2	29	2.1	2.7	2.8	2.3	2.2
15	2.9	2.1	2.2	2.1	2.2	30	2.2	2.7	2.8	2.3	2.2
						31	.....	2.5	.....	2.3	2.2

NOTE.—There was practically no flow during 1907 and none after August, 1908.

Monthly discharge of Matheson canal near Chinook, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1908.				
April 8-30	16	3	10.5	479
May	6	.0	2.97	183
June	8	1	3.77	224
July	2	.0	.419	26
August	3	.0	.806	50

NOTE.—There was practically no flow during 1907. The daily discharges were obtained by a direct comparison of discharge measurements and gage heights and the monthly estimates are only approximate.

HARLEM CANAL NEAR ZURICH, MONT.

This station, which was established in June, 1903, is located about 500 feet below the head-gates of the canal, 1½ miles southeast of the Great Northern Railway section house at Zurich. It is reached by driving from Chinook.

The canal was not in use in 1907, as the head works were out of order.

Discharge measurements of Harlem canal near Zurich, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 27	A. F. Huch	26.5	64.3	3.64	65.7
May 6	do	27	67.8	3.71	67.3
May 15	Stewart and Huch	27	67.7	3.55	61.1
May 25	A. F. Huch	27	63.8	3.70	57.7
June 2	do	27.5	76.5	4.08	78.7
June 12	do	27	65.4	3.26	44.7
June 24	do	15	13.7	1.30	3.3
July 6	do	24	47.4	2.49	27.4
July 17	do	25	57.5	3.00	31.0
August 6	do	16	23.2	2.41	[a] 20.6

[a] Made by wading 50 feet below gage.

NOTE.—All measurements except that of August 6 were made from highway bridge 2 miles below gage.

Daily gage height, in feet, of Harlem canal near Zurich, Mont., for 1908.

[Joel Lean, observer.]

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	3.60	3.90	.....	16	3.10	3.60	.....	3.10
2	.....	3.60	4.10	2.20	17	3.40	3.60	.....	3.00
3	.....	3.50	3.80	2.40	18	3.60	3.60	.....	3.00
4	.....	3.50	3.60	3.00	19	3.60	4.00	.....	3.00
5	.....	3.50	.....	2.70	20	3.70	4.00	.....	2.90
6	.....	3.60	.....	2.60	21	3.50	3.50	.....	2.90
7	2.80	3.70	.....	2.90	22	3.40	3.50	.....	3.00
8	3.00	3.60	.....	3.00	23	3.40	3.50	.....	3.10
9	3.10	3.80	.....	3.00	24	3.60	3.40	.....	.....
10	3.00	3.50	.....	3.00	25	3.60	3.70	.....	.....
11	2.00	3.40	.....	3.00	26	3.50	3.60	.....	.....
12	1.80	3.50	.....	3.00	27	3.60	3.50	.....	.....
13	1.90	3.50	.....	2.90	28	3.80	3.50	.....	.....
14	2.00	3.50	.....	3.00	29	3.70	3.50	.....	.....
15	2.50	3.50	.....	3.10	30	3.70	3.60	.....	.....
					31	.....	3.60	.....	.....

NOTE.—The record stopped July 23 because the only available observer moved away.

Monthly discharge of Harlem canal near Zurich, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 7–30	71	12	49.0	2,330
May	78	50	59.8	3,680
June	79	3	32.2	1,920
July	31	14	27.6	1,700
August	24	5	13.5	830

NOTE.—These values of monthly discharge are approximate, owing to great and irregular fluctuation of the gage height due to canal regulation.

AGENCY DITCH NEAR HARLEM, MONT.

This station, which was established July 14, 1905, is located at the highway bridge about one-fourth mile below the head-gate. It is reached by driving 4 miles south from Harlem, Mont.

The head-gates were opened for the season April 21, 1908, but were closed again for repairs from May 4 to 17, and also June 13 to July 6. The ditch was emptied August 1, 1908, and later a small flow was admitted to furnish water for the steam plow, but not for irrigation.

Discharge measurements of Agency ditch near Harlem, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 18	J. B. Pierson				0.0
May 24	do				.0
July 11	do	16	12.3	2.88	6.9
July 19	do	24	46.9	4.40	19.2
August 2	do			4.38	.0
August 27	do		33.3	3.90	11.8
September 28	Robert Follansbee	20	28.2	3.72	19.4
1908.					
April 4	A. F. Huch			.33	.0
April 24	do	24	46.4	2.42	37.2
May 8	do	17	17.6	1.10	17.0
May 28	do	23	39.2	2.15	37.9
August 11	do	16	15.7	1.40	[a] 13.2

[a] Made by wading.

Daily gage height, in feet, of Agency ditch near Harlem, Mont., for 1907 and 1908.

[J. W. Ijams and C. P. Wells, observers.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1907.					1907.				
1		4.5	4.4	3.9	16	4.6	4.5	4.2	4.2
2		4.5	4.4	3.9	17	4.7	4.5	4.2	4.2
3		4.6	4.4	3.9	18	4.7	4.5	4.0	4.2
4		4.5	4.3	3.9	19	4.65	4.8	4.0	4.0
5		4.45	4.3	3.9	20	4.5	4.8	4.0	3.8
6		4.4	4.3	3.9	21	4.5	4.8	4.0	3.8
7		4.3	4.3	3.9	22	4.4	4.7	4.0	3.7
8		4.35	4.3	4.0	23	4.5	4.7	4.0	3.7
9		4.4	4.3	4.0	24	5.35	4.7	4.0	3.7
10		3.7	4.3	4.0	25	6.6	4.6	4.0	3.7
11		2.8	4.2	4.1	26	5.5	4.6	3.8	3.7
12		4.0	4.2	4.1	27	5.5	4.5	3.8	3.7
13		4.5	4.2	4.1	28	5.35	4.5	3.8	3.7
14		4.8	4.2	4.1	29	4.5	4.4	3.8	3.7
15		4.8	4.2	4.2	30	4.5	4.4	3.8	3.7
					31		4.4	3.8	3.7

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1908.					1908.				
1		2.20	2.05		16				3.55
2		2.20	2.25		17				3.6
3		2.20	2.50		18		2.30		3.5
4		1.65	2.75		19		2.45		3.5
5			2.85		20		2.65		3.45
6			2.95		21		2.80		3.4
7			3.00		22	1.30	2.75		3.3
8			3.10	3.45	23	2.45	2.65		3.3
9			3.10	3.5	24	2.60	2.45		3.3
10			3.20	3.6	25	2.50	2.35		3.3
11			3.20	3.7	26	2.45	2.30		3.3
12			3.20	3.75	27	2.25	2.20		3.3
13				3.7	28	2.20	2.10		3.3
14				3.7	29	2.25	2.10		3.3
15				3.6	30	2.15	2.10		3.3
					31		2.10		3.3

NOTE.—These gage heights are affected by the canal regulation.

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

This station, which was established June 21, 1903, is located at the highway bridge about 500 feet below the head-gates of the canal, 8 miles east of Chinook.

The high water of June, 1908, washed out both the bridge and the gage. A new gage was installed on June 27, 1908, at a different datum, within a few feet of the site of the old gage.

A new bridge was built about one-fourth mile upstream from the site of the old one. Measurements can be made from this bridge only when the canal is running full. Wading measurements are made at a section about 300 feet downstream from the gage.

There was flow in the canal on the single days for which gage heights are missing. During a few of the days when the canal was at its highest, owing to the flood in Milk River, the water was wasted, but the greater part of the time from June 5 to 30 the water was used for irrigation.

The head-gates were closed for the season September 22, 1907, and September 23, 1908.

Discharge measurements of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14	J. B. Pierson	36	67.5	3.45	108
May 20	do	27	42.6	2.80	56.0
June 3	do	25	32.4	2.45	40.1
July 5	do	25	34.6	2.89	25.0
July 17	do	24	33.7	2.88	33.6
July 29	do	27	36.1	3.11	54.4
August 16	Follansbee and Pierson	32	48.6	3.45	66.9
August 19	J. B. Pierson	30	44.1	3.39	60.7
August 26	do	25	31.3	3.00	39.3
September 10	do	30	39.9	3.25	54.3
September 27	Robert Follansbee	15	12.2	2.10	7.7
1908.					
April 10	Stewart and Huch	18	18.9	2.47	22.4
April 23	A. F. Huch	38	66.2	3.70	106
May 7	do	38	60.9	3.69	88.3
May 16	do	38	61.7	3.69	97.7
May 23	do	40	63.4	3.78	109
June 1	do	41	66.4	3.82	108
August 4	do	33	51.9	2.91	*a* 63.4
August 12	do	33	53.0	2.99	*a* 69.1

a Made by wading.

Daily gage height, in feet, of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

[Bruce Glenn, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1907.						1907.					
1			2.8	3.4	3.3	16	2.9		2.9	3.4	2.4
2			2.9	3.3	3.4	17	2.9		2.9	3.5	2.4
3		2.45	2.9	3.2	3.4	18	2.9		2.9	3.5	2.6
4			2.9	3.2	3.4	19			2.9	3.5	2.6
5			2.9	3.2	3.2	20			2.8	3.5	2.5
6				3.5	3.2	21			2.9	3.5	2.5
7			2.9	3.5	3.2	22			3.0	3.4	
8			2.8	3.5	3.2	23			3.2	3.4	
9			2.8	3.5	3.0	24			3.2	3.2	
10			2.8	3.6	3.2	25			3.2	3.1	
11			3.1	3.6	3.0	26			3.2	3.1	
12	3.25		3.1	3.6	3.0	27			3.1	3.0	
13	3.4		3.1	3.6	2.4	28			3.1	3.0	
14	3.32		3.0	3.4	2.4	29			3.3	3.0	
15	3.0		3.0	3.4	2.4	30			3.5	3.0	
						31			3.5	3.3	

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1908.							1908.						
1		3.72	3.92	3.00	3.00	2.70	16	3.39	3.74		3.45		2.70
2		3.60	3.80	3.10	2.90	2.70	17	3.85			3.45	2.90	2.65
3			3.75	3.05	2.90	2.65	18	3.85	4.00		3.48	2.90	2.60
4		3.75	3.70		2.90	2.65	19	3.82	3.90		3.40	2.85	2.60
5		3.80		3.10	2.90	2.65	20	3.80	3.88		3.40	2.85	2.60
6		3.70		3.15	2.90		21	3.75	3.90		3.42	2.85	2.60
7		3.60		3.18	2.85	2.65	22	3.76	3.85		3.45	2.80	2.80
8		3.50		3.20	2.85	2.65	23	3.75	3.82		3.45		2.60
9		3.45		3.22		2.65	24	3.80			3.40	2.80	
10	2.45			3.28	2.90	2.60	25	3.85	3.78		3.40	2.80	
11	3.45	3.41		3.30	2.90	2.65	26	3.80	3.82		3.25	2.80	
12	3.70	3.55		3.32	2.92	2.65	27	3.86	3.90		3.20	2.80	
13	3.70	3.65		3.32	2.95		28	3.80	3.95		3.10	2.75	
14	3.68	3.68		3.40	2.98	2.65	29	3.72	3.92		3.05	2.75	
15	3.45	3.75		3.40	2.98	2.70	30	3.75	3.95		3.00		
							31		3.95		3.00	2.75	

NOTE.—No observer available from May 19–June 30, 1907, although the canal was in use.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
May 12–18	102	62	77.4	1,070
July	78	22	38.8	2,390
August	75	39	62.0	3,810
September 1–21	62	16	36.7	1,530
1908.				
April 10–30	120	22	105	4,370
May	126	76	102	6,270
June	110	85	87.7	5,220
July	109	70	90.4	5,560
August	70	52	60.4	3,710
September 1–23	56	43	46.2	2,110

NOTE.—These values of monthly discharge are only approximate owing to the great and irregular fluctuation of the gage height due to canal regulation.

WINTER-ANDERSON CANAL NEAR CHINOOK, MONT.

This station, which was established April 22, 1906, is located at the highway bridge 5 miles east of Chinook and one-half mile west of James Cook's ranch house.

The canal was not in use during the season of 1907.

The gage was washed out June 11, 1908 and the head-gates were so badly damaged that it was impossible for water to flow in the canal after June 24, 1908. There was little flow before May 20 and none after June 20, 1908.

Discharge measurements of Winter-Anderson canal near Chinook, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 7	Stewart and Huch			2.63	0.0
April 27[a]	A. F. Huch			3.20	
May 6[a]	do			2.83	
May 15	Stewart and Huch			2.40	0
May 25[b]	A. F. Huch	5.5	6.6	3.19	2.1
June 2[c]	do	13	11.2	3.5	5.8
June 12[b]	do	5.5	8.2		4.2
June 24	do				0

[a] Canal not in use.
[b] Measurement made at a flume about 1 mile below gage.
[c] Made by wading 25 feet above gage.

Daily gage height, in feet, of Winter-Anderson canal near Chinook, Mont., for 1908.

[Freddie Bosch, observer.]

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1			3.30	11				21		3.6	
2			3.65	12				22		3.5	
3		3.10	3.50	13				23		3.4	
4		3.20	3.48	14				24		3.3	1.1
5		3.10	3.55	15				25	3.1	3.3	1.1
6		3.10	3.65	16				26	3.2	3.3	1.1
7	2.60		3.72	17				27	3.2	3.4	1.2
8			4.15	18				28	3.1	3.3	1.2
9			4.20	19				29		3.1	1.3
10			4.05	20		3.5		30		3.2	1.3
								31		3.3	

NOTE.—Gage washed out June 11, 1908.

Monthly discharge of Winter-Anderson canal near Chinook, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 25-28			1.50	12
May, 16 days	7	1	3.12	99
June, 20 days	24	1	6.85	272

NOTE.—These values are only approximate owing to the great and irregular fluctuation in daily gage heights due to canal regulation.

ROCK CREEK CANAL NEAR HINSDALE, MONT.

This station, which was established July 5, 1905, is located about 300 feet below the head-gates of the canal and is reached by driving 3½ miles north from Hinsdale. It was discontinued December 31, 1907.

During the spring of 1907 the canal contained a large amount of water, owing to the fact that the head-gates had been washed out. This water was not used for irrigation until after July 12, 1907.

Discharge measurements of Rock Creek canal near Hinsdale, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 31	J. B. Pierson	12	12.6	2.00	3.1
August 28	do	5	1.9	1.80	2.8
October 21	do				[a]1.5

[a] Estimated.

Daily gage height, in feet, of Rock Creek canal near Hinsdale, Mont., for 1907.

[F. E. Halbert, observer.]

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		3.1	11	1.8		21	1.8	
2	1.9	2.9	12	1.8		22	1.8	
3	1.9	2.9	13	1.8		23	1.8	
4	1.9	2.9	14	1.9		24	1.8	
5	1.8	2.9	15	1.9		25	1.8	
6	1.8	2.9	16	1.9		26	1.8	
7	1.8	2.9	17	1.9		27	1.8	
8	1.8	2.9	18	1.8		28	1.8	
9	1.8	2.8	19	1.8		29	1.8	
10	1.8	2.7	20	1.8		30	1.8	
						31	2.6	

NOTE.—Gage heights after August 30 affected by canal regulation.

LITTLE PORCUPINE CREEK DRAINAGE BASIN.

LITTLE PORCUPINE CREEK NEAR FRAZER, MONT.

Little Porcupine Creek rises near the central-western part of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near Frazer, Mont.

The drainage area comprises a strip of land about 25 miles long, extending but a short distance back from the narrow valley bordering the stream. Except for a growth of cottonwood and willows the basin is without forestation.

The run-off comes from the melting snow in the spring and from heavy rains during the summer. During the greater part of the year the channel is dry, except for about one-half second-foot of water derived from springs near the mouth of the stream. The annual rainfall is about 13 inches. The stream is not used for diversion.

The only gaging station in this basin is about 2 miles south of Frazer, Mont. It was established July 13, 1908, to obtain data for use in connection with an irrigation project being constructed by the United States Reclamation Service for the Fort Peck Indians.

Discharge measurements of Little Porcupine Creek near Frazer, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12[a]	A. F. Huch	.....	0.2	1.42	0.4
August 14	Stewart and Huch	2.0	.62	1.41	.4

[a] Made by floats.

Daily gage height, in feet, of Little Porcupine Creek near Frazer, Mont., for 1908.

[T. C. Flynn, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.5	1.4	1.4	1.5	1.5	16	1.5	1.4	1.4	1.5	1.5	1.5
2	.....	1.5	1.4	1.4	1.5	1.5	17	1.5	1.4	1.4	1.5	1.4	1.5
3	.....	1.5	1.4	1.4	1.4	1.5	18	1.6	1.4	1.4	1.5	1.4	1.5
4	.....	1.4	1.4	1.4	1.4	1.5	19	1.6	1.4	1.4	1.5	1.4	1.5
5	.....	1.4	1.4	1.4	1.4	1.5	20	1.5	1.4	1.4	1.5	1.4	1.5
6	.....	1.4	1.4	1.4	1.4	1.5	21	1.4	1.4	1.4	1.5	1.4	1.5
7	.....	1.4	1.4	1.4	1.5	1.5	22	1.4	1.4	1.4	1.4	1.4	1.5
8	.....	1.4	1.4	1.4	1.5	1.5	23	1.4	1.4	1.4	1.4	1.4	1.5
9	.....	1.4	1.4	1.4	1.5	1.5	24	1.4	1.4	1.4	1.4	1.4	1.5
10	.....	1.4	1.4	1.4	1.4	1.5	25	1.4	1.4	1.4	1.4	1.4	1.5
11	.....	1.4	1.4	1.5	1.4	1.5	26	1.4	1.4	1.4	1.4	1.4	1.5
12	1.4	1.4	1.4	1.5	1.5	1.5	27	1.4	1.4	1.4	1.5	1.4	1.5
13	1.4	1.4	1.4	1.5	1.5	1.5	28	1.4	1.4	1.4	1.5	1.4	1.5
14	1.4	1.4	1.4	1.5	1.5	1.5	29	1.4	1.4	1.4	1.5	1.5	1.5
15	1.4	1.4	1.4	1.5	1.5	1.5	30	1.5	1.4	1.4	1.5	1.5	1.5
							31	1.5	1.4	.....	1.5	.....	1.5

NOTE.—Ice conditions in December.

WOLF CREEK DRAINAGE BASIN.

WOLF CREEK AT WOLF POINT, MONT.

Wolf Creek rises near the center of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near the Wolf Point Agency. The drainage area comprises the central part of the Fort Peck Indian Reservation. The entire area with the exception of a narrow valley along the stream is a rolling prairie. The only forestation is the growth of willows and cottonwoods along the banks of the streams.

The run-off comes from the melting snow in the spring and heavy rains during the summer. The upper part of the channel is dry during the late summer and winter, but near the mouth the flow is kept up by springs. The annual rainfall is about 13 inches. The stream is not used for storage and the only diversion is that made by the Indian Agency ditch at Wolf Point, which diverts the entire flow during the low period.

The gaging station, which was established August 15, 1908, to determine the amount of water available for an irrigation project under consideration by the United States Reclamation Service for the Fort Peck Indians, is located at William Smith's ranch, 2½ miles northwest of Wolf Point.

The following discharge measurement was made at this station:

August 15, 1908: Gage height, 1.51 feet; discharge estimated as 0.2 second-foot.

Daily gage height, in feet, of Wolf Creek at Wolf Point, Mont., for 1908.

[W. H. Smith, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.5	1.6	1.65	1.7	16	1.5	1.6	1.6	1.7	.....
2	.....	1.5	1.6	1.65	1.7	17	1.5	1.5	1.6	1.7	.....
3	.....	1.5	1.6	1.65	1.7	18	1.5	1.5	1.6	1.7	.....
4	.....	1.5	1.6	1.65	.....	19	1.5	1.5	1.6	1.7	.....
5	.....	1.5	1.6	1.65	.....	20	1.5	1.5	1.6	1.7	.....
6	.....	1.5	1.6	1.65	.....	21	1.6	1.5	1.6	1.7	.....
7	.....	1.6	1.6	1.65	.....	22	1.5	1.5	1.6	1.7	.....
8	.....	1.6	1.6	1.7	.....	23	1.5	1.5	1.6	1.7	.....
9	.....	1.6	1.6	1.7	.....	24	1.5	1.5	1.6	1.7	.....
10	.....	1.6	1.6	1.7	.....	25	1.5	1.5	1.65	1.7	.....
11	.....	1.5	1.6	1.7	.....	26	1.6	1.5	1.65	1.7	.....
12	.....	1.5	1.6	1.7	.....	27	1.6	1.5	1.65	1.7	.....
13	.....	1.5	1.6	1.7	.....	28	1.6	1.5	1.65	1.7	.....
14	.....	1.6	1.6	1.7	.....	29	1.5	1.5	1.65	1.7	.....
15	1.5	1.6	1.6	1.7	.....	30	1.5	1.5	1.65	1.7	.....
						31	1.5	.....	1.65	.....	.....

POPLAR CREEK DRAINAGE BASIN.

POPLAR CREEK NEAR POPLAR, MONT.

Poplar Creek rises in the southern part of the Canadian province of Saskatchewan, flows southeastward through the northern part of Valley County, Mont., thence through the Fort Peck Indian Reservation, and unites with Missouri River near Poplar, Mont. The largest tributary is the West Branch, which enters near the north boundary of the Fort Peck Reservation. The greater part of the drainage area is a rolling prairie cut by a number of small coulees and the valley of the creek. The only forestation is a growth of willows and cottonwoods along the banks of the stream.

The run-off comes from melting snow in the spring and heavy rains during the summer. The dry-season flow is considerable. The annual rainfall at Poplar is about 13 inches.

The United States Reclamation Service has under consideration a project which will divert the water of this stream to irrigate land along its lower course and along Missouri River near Poplar, Mont.

The gaging station was established August 15, 1908, at Buershia's ranch, 6 miles north of Poplar, Mont.

The following discharge measurement was made by wading at this station August 15, 1908:

Width, 31 feet; area of section, 7.30 square feet; gage height, 2.48 feet; and discharge, 9.9 second-feet.

Daily gage height, in feet, of Poplar Creek near Poplar, Mont., for 1908.

[R. W. Henry and Neol Buershia, observers.]

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	2.7	2.7	16	.....	2.65	2.9	.....
2	.....	2.5	2.7	2.7	17	2.9	2.55	2.9	.....
3	.....	2.9	2.7	2.7	18	2.9	2.55	2.9	.....
4	.....	2.9	2.7	2.7	19	2.9	2.5	3.0	.....
5	.....	2.9	2.7	2.7	20	2.9	2.45	3.0	.....
6	.....	2.9	2.7	2.7	21	2.9	2.4	3.0	.....
7	.....	2.9	2.7	2.7	22	2.9	2.4	3.0	.....
8	.....	2.9	2.95	2.7	23	2.9	2.4	3.0	.....
9	.....	2.9	2.95	2.7	24	2.9	2.4	3.0	.....
10	.....	2.9	2.95	2.7	25	2.9	2.4	3.0	.....
11	.....	2.9	2.8	2.7	26	2.5	2.4	3.0	.....
12	.....	2.9	2.95	.....	27	2.5	2.4	2.75	.....
13	.....	2.8	2.95	.....	28	2.5	2.4	2.7	.....
14	.....	2.7	2.95	.....	29	2.5	2.45	2.7	.....
15	.....	2.7	2.9	.....	30	2.5	2.45	2.7	.....
					31	2.5	.....	2.7	.....

BIG MUDDY RIVER DRAINAGE BASIN.

BIG MUDDY RIVER NEAR CULBERTSON, MONT.

Big Muddy River rises in the Province of Saskatchewan, Canada, flows southward into Montana, forms the eastern boundary of the Fort Peck Indian Reservation, and unites with Missouri River near Blair, Mont. It drains a rolling prairie country cut by many small coulees. The greater part of the run-off comes from the melting snow in the spring months.

The gaging station, which was established July 14, 1908, to determine the amount of water available for irrigation projects under consideration by the United States Reclamation Service for the Fort Peck Indians, is located about 3 miles above the mouth of the stream.

Gage readings are affected by backwater from the Missouri, and are therefore not reliable except at low-water stage of the Missouri. Frequent discharge measurements are necessary in order to obtain good results.

The following discharge measurement was made by wading at this station August 16, 1908:

Width, 9 feet; area of section, 14.7 square feet; gage height, 1.7 feet; discharge, 6.3 second-feet.

Daily gage height, in feet, of Big Muddy River near Culbertson, Mont., for 1908.

[James Boyd, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			1.4	1.55	2.05	1.85	16		1.7	1.3	1.75	1.9	
2			1.4	1.5	2.05	1.8	17		1.7	1.25	1.8	1.9	
3			1.4	1.5	2.0	1.8	18		1.65	1.25	1.8	1.9	
4			1.4	1.55	2.0	1.85	19		1.6	1.3	1.75	1.95	
5			1.4	1.55	1.95	1.85	20		1.6	1.3	1.85	1.95	
6			1.4	1.55	1.95		21		1.6	1.3	1.85	1.85	
7			1.4	1.55	2.0		22		1.6	1.3	1.85	1.85	
8			1.4	1.6	1.9		23		1.55	1.3	1.85	1.9	
9			1.4	1.65	2.0		24		1.55	1.3	1.9	1.95	
10			1.35	1.8	1.9		25		1.5	1.3	1.95	2.0	
11			1.35	1.8	1.9		26		1.5	1.3	1.85	2.25	
12			1.35	1.85	1.9		27		1.5	1.5	1.85	2.2	
13			1.35	1.85	1.9		28		1.45	1.55	1.95	1.95	
14	1.4		1.35	1.85	1.9		29		1.45	1.55	2.0	1.85	
15			1.35	1.8	1.9		30		1.4	1.55	1.95	2.0	
							31		1.4		2.05		

NOTE.—Ice conditions November 10 to 16 and December 5 to 31, 1908.

YELLOWSTONE RIVER DRAINAGE BASIN.

DESCRIPTION.

The upper Yellowstone rises in the Shoshone Mountains, in northwestern Wyoming, near the southeast corner of the Yellowstone National Park, flows northwestward for 40 or 50 miles, and then enters Yellowstone Lake, which may be considered the great source

of the main river. This lake is about 15 miles long by 20 miles wide, lies at an elevation of 7,778 feet above the sea, and is hemmed in on every side by lofty mountains from whose snow-covered slopes its chief supply of water must come, since it receives no important streams. Issuing from the lake at the north end the river flows northwestward for 10 or 15 miles, plunges over the Great Falls of the Yellowstone, and for the next 20 miles runs through its "Grand Canyon," which is impassable throughout. About 80 miles from the lake it emerges from the Snow Mountains, and thence runs eastward and northeastward until it joins the Missouri at Fort Buford, N. Dak. At this point it has an elevation of about 1,900 feet.

As it leaves the mountains the river is about 600 feet wide; thence to Clark Fork, which enters from the south about 15 miles above Billings, Mont., it is characterized by bold, sweeping curves, and many islands. Between Clark Fork and the mouth of the Bighorn it is from 1,500 to 1,800 feet wide, is free from rapids, and has a current from 3 to 4 miles an hour. Between the Bighorn and the Powder the main stream increases in width from 2,400 to 2,700 feet, and becomes turbid like the Missouri. Below the mouth of the Powder the banks are low and caving and the stream contains some rapids and shoals and numerous densely timbered islands.

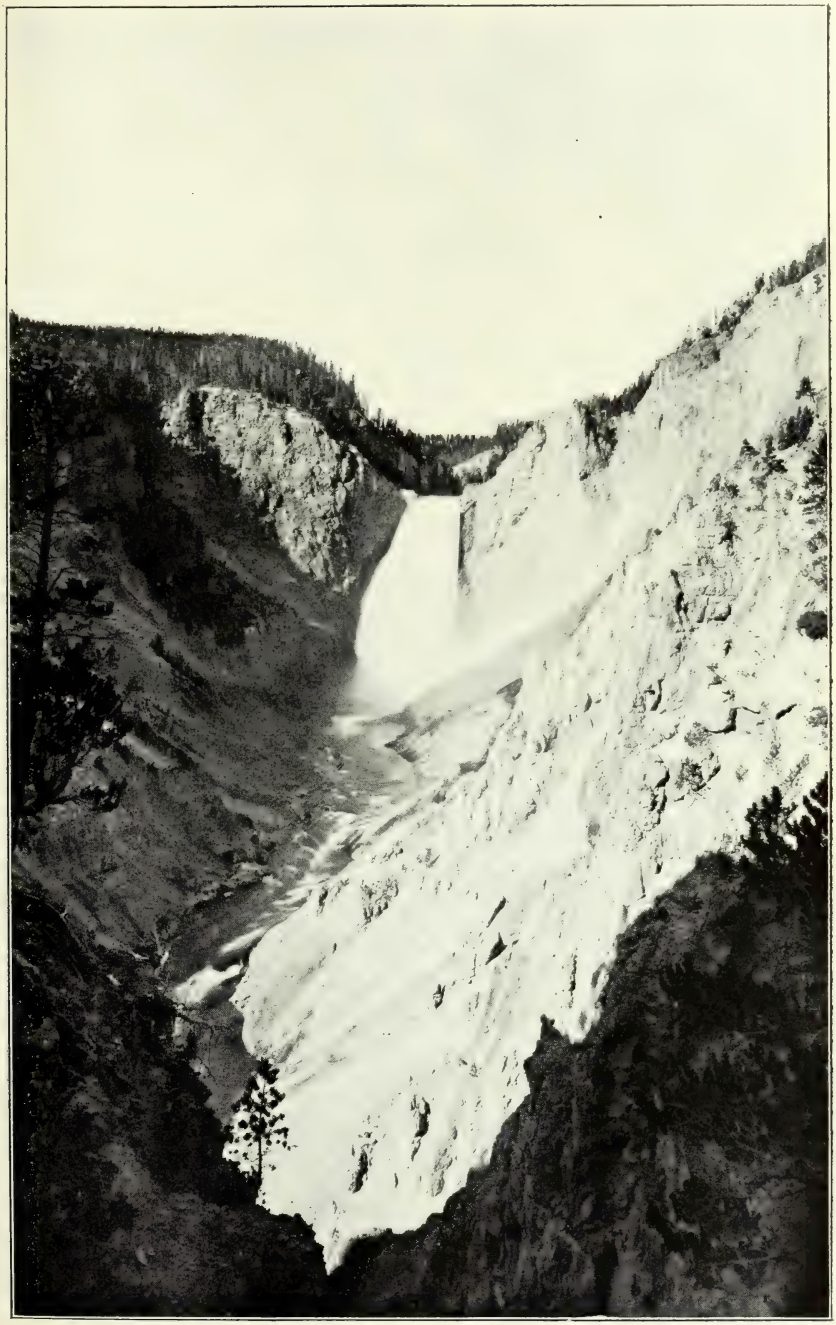
The Yellowstone is about 500 miles long; the area of its basin is approximately 67,500 square miles.

Of the tributaries of the Yellowstone the most important is the Bighorn,[a] which has its source in the many small streams draining the slopes of the Wind River Range. Other important tributaries of the Yellowstone are Shields, Boulder, Big Timber, Sweetgrass, Stillwater, Clark Fork, Tongue, and Powder rivers. Shields, Big Timber, and Sweetgrass rivers have their sources in the Crazy Mountains, rising to an elevation of 10,000 feet; the Boulder, Stillwater, and Clark Fork rise on the southeastern slope of the Shoshone Mountains at an elevation of 10,500 feet. Powder and Tongue rivers have their sources in the high plains region and Bighorn Mountains of Wyoming, flowing parallel and in a northeasterly direction until they join the Yellowstone.

The headwaters of the Yellowstone and many of its tributaries drain portions of heavily timbered areas. The Yellowstone, Crazy Mountain, Bighorn, and Otter national forests are thus drained. However, the greater part of the drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream channels.

The mean annual rainfall in Yellowstone Park is approximately 17 inches; at Billings, 15 inches; Glendive, 10 inches; and at Buford

[a] See description of basin on p. 178.



LOWER FALLS OF THE YELLOWSTONE, YELLOWSTONE NATIONAL PARK.

12½ inches. A greater portion of the rainfall occurs in June. Snow lies in the mountains from November to June. The streams are partly frozen during the colder months.

The great areas of irrigable land and the abundant water supply afford wonderful opportunities for irrigation in the Yellowstone basin. The United States Reclamation Service has practically completed irrigation projects diverting water from the Yellowstone and reclaiming 100,000 acres of arid land. The Shoshone project, reclaiming 132,000 acres, is partly finished. Several private irrigation projects are completed and more are under construction.

Many possible reservoir sites for the storage of flood water are found on the upper portion of the Yellowstone and its tributaries. Shoshone dam, 325 feet high, on the Shoshone River, stores 456,000 acre-feet.

The Yellowstone basin contains many natural power sites. The abundance of water and the magnitude of fall in the higher altitudes make the development of hydroelectric power most feasible. (Pl. V.) Power for municipal purposes is now generated at Livingston, Big Timber, and Billings.

The run-off record extends back to 1889, although a few stream measurements were made on the Yellowstone River in the National Park as early as 1878. The wettest year recorded at Livingston from 1897 to 1908 was 1899; the driest was 1905.

The following gaging stations have been maintained in this basin:

Yellowstone River near Horr, Mont., 1888–1895.
Yellowstone River at Livingston, Mont., 1897–1905.
Yellowstone River at Billings, Mont., 1904–5.
Yellowstone River at Huntley, Mont., 1907–8.
Yellowstone River at Junction, Mont., 1906–7.
Yellowstone River at Glendive, Mont., 1897–1908.
North Fork of Big Timber Creek near Big Timber, Mont., 1907–8.
South Fork of Big Timber Creek near Big Timber, Mont., 1907–8.
East Fork of Boulder River near McLeod, Mont., 1907–8.
West Fork of Boulder River near Bruffeys, Mont., 1907–8.
West Fork of Boulder River near McLeod, Mont., 1907–8.
Sweetgrass Creek above Mellville, Mont., 1907–8.
Sweetgrass Creek below Mellville, Mont., 1907–8.
Clark Fork near Fromberg, Mont., 1905–6.
Pryor Creek near Huntley, Mont., 1904–1906.
Big Wind River near Riverton, Wyo., 1906–1908.
Bighorn River near Hardin, Mont., 1904–1908.
Bighorn River at Thermopolis, Wyo., 1900–1905.
Little Wind River at Fort Washakie, Wyo., 1908.
Little Wind River above Arapahoe Agency, Wyo., 1906–1908.
Little Wind River below Arapahoe Agency, Wyo., 1906–1908.
Little Popo Agie River at Hudson, Wyo., 1907–8.
Gray Bull Creek near Meeteetse, Wyo., 1897, 1903.
Shoshone River at Cody, Wyo., 1902–1908.
Shoshone River at Corbett Dam, Wyo., 1908.

Shoshone River near Lovell, Wyo., 1897–1899.
South Fork of Shoshone River at Marquette, Wyo., 1903–1908.
Little Bighorn River at Crow Agency, Mont., 1905–6.
Tongue River near Dayton, Wyo., 1903.
Big Goose Creek near Sheridan, Wyo., 1895–1897.
Little Goose Creek near Sheridan, Wyo., 1896–97.
Clear Creek at Buffalo, Wyo., 1896–1904.
Piney Creek at Kearney, Wyo., 1902–1906.
Cruez ditch near Story, Wyo., 1903.

YELLOWSTONE RIVER AT HUNTLEY, MONT.

This station, which is located at the new steel highway bridge 1 mile below Huntley, Mont., and replaces that formerly maintained at Junction, was established October 1, 1907, to obtain data applicable to irrigation and power development.

The only tributary near the station is Pryor Creek, which enters the Yellowstone 1 mile above. The drainage area at Huntley is about 12,000 square miles.

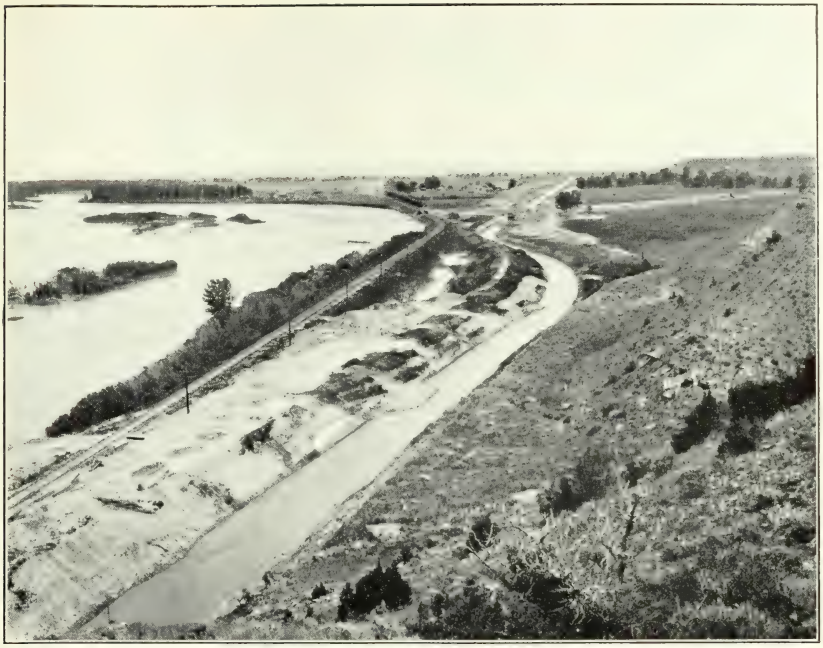
The Huntley canal (Pl. VI, *A*), built by the United States Reclamation Service, takes water from the river about 2 miles above the gaging station; its normal capacity is 400 second-feet, and it supplies water for 29,000 acres of land. Near Laurel are the headgates of the Billings Land and Irrigation Company's large canal, which carries about 305 second-feet and irrigates 28,000 acres. Many small ditches take water from the tributaries of the Yellowstone but few from the stream itself owing to the variation of the stages of the water surface and consequent difficulty in diversion.

This river freezes entirely over in places during the winter, but during the coldest seasons open channels with floating ice are not uncommonly seen. Conditions for obtaining accurate data at this station are only fair, as the channel is shifting and extra measurements are necessary to obtain a good rating curve. The gage datum has remained the same.

Discharge measurements of Yellowstone River at Huntley, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 1	J. E. Stewart	471	2,490	3.00	5,840
November 15	do	446	2,100	2.20	3,340
1908.					
March 28	J. E. Stewart	436	1,890	1.83	2,270
May 21	do	507	3,130	4.41	12,700
June 15	Raymond Richards	559	[a] 5,160	8.87	39,800
July 22	do	518	3,310	5.37	16,600
October 12	J. E. Stewart	446	1,740	2.67	5,000

[a] Area computed from soundings of July 22, 1908.



A. MAIN CANAL, HUNTLEY PROJECT, MONTANA.

B. PRYOR CREEK WEIR DURING SPRING FLOOD, HUNTLEY PROJECT, MONTANA.

Daily gage height, in feet, of Yellowstone River at Huntley, Mont., for 1907 and 1908.

[Jack O'Neil and Arthur Foster, observers.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1907.				1907.				1907.			
1	3.0	2.4	2.1	11	2.7	2.3	2.0	21	2.6	2.2	1.2
2	3.0	2.4	2.1	12	2.7	2.2	2.0	22	2.6	2.2	1.2
3	3.1	2.4	2.1	13	2.7	2.2	2.0	23	2.6	2.2	1.2
4	3.0	2.3	2.1	14	2.7	2.2	2.0	24	2.5	2.2	1.2
5	3.0	2.3	2.0	15	2.7	2.2	1.8	25	2.5	2.2	1.2
6	2.8	2.3	2.0	16	2.7	2.2	1.8	26	2.5	2.2	1.1
7	2.8	2.3	2.0	17	2.6	2.2	1.7	27	2.5	2.2	1.1
8	2.8	2.3	2.0	18	2.6	2.2	1.5	28	2.4	2.2	1.1
9	2.8	2.3	2.0	19	2.6	2.2	1.2	29	2.4	2.2	1.4
10	2.8	2.3	2.0	20	2.6	2.2	1.2	30	2.4	2.1	1.5
								31	2.4	.....	1.6

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1.70	1.60	2.90	1.82	2.50	7.80	6.90	4.40	3.20	2.70	2.60	1.80
2	1.70	1.50	.....	1.78	2.50	8.00	7.60	4.40	3.20	2.70	2.60	1.50
3	1.70	1.50	.....	1.78	2.60	7.70	7.80	4.30	3.10	2.78	2.60	1.60
4	1.60	1.50	.....	1.70	3.07	7.90	7.80	4.20	3.00	2.00	2.60	2.00
5	1.60	1.70	2.40	1.69	3.40	6.70	7.60	4.20	3.00	2.98	2.60	2.00
6	2.00	1.90	.....	1.70	3.60	6.70	6.20	4.10	3.00	3.00	2.60	2.50
7	2.00	2.00	.....	1.70	3.70	6.70	6.20	3.90	3.00	2.96	2.60	2.20
8	2.00	2.10	2.40	1.70	4.03	6.90	7.40	3.80	3.00	2.90	2.58	2.25
9	2.00	2.20	.....	1.71	4.60	7.10	7.60	3.70	2.80	2.90	2.58	2.25
10	2.00	.....	.....	1.80	4.80	7.70	7.60	3.70	2.80	2.80	2.58	2.30
11	2.00	.....	.....	1.87	4.90	7.80	7.80	3.60	2.80	2.80	2.53	2.20
12	2.00	.....	2.50	1.92	4.80	7.80	7.50	3.60	2.80	2.67	2.53	2.10
13	2.00	.....	.....	1.94	4.00	8.80	7.50	3.90	2.80	2.67	2.53	2.10
14	2.00	.....	.....	1.97	3.80	9.00	7.20	3.90	2.80	2.67	2.50	2.10
15	2.00	.....	3.00	2.12	3.80	9.00	6.80	3.80	2.80	2.70	2.50	2.10
16	1.90	2.00	.....	2.30	3.73	9.00	6.80	3.80	2.76	2.71	2.50	2.00
17	1.90	.....	.....	2.45	3.84	9.10	6.30	3.80	2.76	2.90	2.50	2.00
18	1.90	.....	.....	2.53	3.60	9.00	6.20	3.80	2.76	2.97	2.56	1.80
19	1.90	2.40	2.90	2.60	3.60	8.50	6.00	3.70	2.76	3.00	2.50	1.70
20	2.20	2.40	.....	3.00	3.20	7.80	5.60	3.60	2.60	2.98	2.56	1.90
21	2.20	.....	.....	3.11	4.40	7.00	5.50	3.60	2.78	2.96	2.56	2.00
22	2.20	.....	1.85	3.13	3.98	7.00	5.40	3.60	2.78	2.96	2.30	1.95
23	2.20	2.10	1.85	3.70	4.10	6.80	5.36	3.50	2.78	2.94	2.28	1.95
24	2.20	.....	1.85	3.72	4.80	6.70	5.30	3.62	2.76	2.94	2.22	1.95
25	2.20	.....	1.85	3.70	4.00	6.50	5.20	3.50	2.70	2.90	2.20	2.10
26	2.20	.....	1.85	3.68	4.30	6.20	5.20	3.45	2.70	2.80	2.20	2.25
27	2.20	3.00	1.85	3.30	8.00	7.50	5.10	3.33	2.70	2.18	2.10	2.25
28	2.20	.....	1.85	3.10	7.65	8.40	5.10	3.22	2.70	2.88	2.10	2.20
29	2.00	.....	1.85	2.90	6.75	7.20	5.00	3.15	2.70	2.85	2.10	2.20
30	2.00	.....	1.85	2.50	6.10	7.05	4.90	3.20	2.70	2.84	2.00	2.00
31	1.90	.....	1.85	2.40	7.20	.....	4.80	3.20	.....	2.84	.....	1.90

NOTE.—Practically no ice during December, 1908.

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Rating table for Yellowstone River at Huntley, Mont., for October 1, 1907, to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	1,060	2.40	4,000	3.70	8,900	6.00	20,900
1.20	1,220	2.50	4,320	3.80	9,340	6.20	22,100
1.30	1,380	2.60	4,640	3.90	9,800	6.40	23,340
1.40	1,540	2.70	4,980	4.00	10,260	6.60	24,600
1.50	1,700	2.80	5,320	4.20	11,200	6.80	25,880
1.60	1,860	2.90	5,680	4.40	12,160	7.00	27,160
1.70	2,050	3.00	6,040	4.60	13,160	7.20	28,480
1.80	2,270	3.10	6,420	4.80	14,180	7.40	29,800
1.90	2,520	3.20	6,800	5.00	15,220	7.60	31,120
2.00	2,800	3.30	7,200	5.20	16,300	7.80	32,440
2.10	3,080	3.40	7,600	5.40	17,400	8.00	33,760
2.20	3,380	3.50	8,020	5.60	18,540	9.00	40,560
2.30	3,680	3.60	8,460	5.80	19,700	9.10	41,240

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1907–8 and is well defined.

Monthly discharge of Yellowstone River at Huntley, Mont., for 1907 and 1908.

[Drainage area, 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
October	6,420	4,000	4,930	0.411	0.47	303,000	A.
November	4,000	3,080	3,510	.292	.33	209,000	A.
December	3,080	1,060	2,110	.176	.20	130,000	B.
1908.							
January	3,380	1,860	2,790	.232	.27	172,000	C.
February	.....	.....	1,870	.156	.17	108,000	D.
March	.....	.....	1,880	.157	.18	116,000	D.
April	8,990	2,030	4,470	.372	.42	266,000	A.
May	33,800	4,320	12,700	1.06	1.22	781,000	A.
June	41,200	22,100	31,500	2.62	2.92	1,870,000	A.
July	32,400	14,200	23,400	1.95	2.25	1,440,000	A.
August	12,200	6,610	9,070	.756	.87	559,000	A.
September	6,800	4,640	5,450	.454	.51	324,000	A.
October	6,040	2,800	5,420	.452	.52	333,000	A.
November	4,640	2,800	4,140	.345	.38	246,000	B.
December	4,320	1,700	2,940	.245	.28	181,000	B.
The year	41,200	.....	8,800	.733	9.99	6,400,000	

YELLOWSTONE RIVER AT JUNCTION, MONT.

This station, which was established May 10, 1906, to take the place of the one maintained at Billings, is located at the county highway bridge at Junction, 1 mile north of Custer, Mont. The records furnish information of value in connection with irrigation projects. It was discontinued December 31, 1907, in favor of the station at Huntley.

The Bighorn, which joins the Yellowstone about 7 miles below the gaging station, is the only important tributary near Junction. The drainage area is 13,500 square miles.

No diversions are made from the Yellowstone itself near this station. The high banks and the variations in the height of the water surface make irrigation on a small scale impracticable.

Ice forms at this station, but records obtained during the open season were good. The channel shifts only in extreme high water. The gage datum remained unchanged.

Discharge measurements of Yellowstone River at Junction, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	J. E. Stewart	394	2,130	3.56	3,480
May 30	do	596	3,420	5.76	13,600
June 23	do	609	5,400	9.10	[a] 37,700
July 11	do	608	5,490	9.74	38,800
August 15	do	450	3,310	5.41	11,600
November 16	do	384	2,430	3.71	3,520

[a] Measurement doubtful.

Daily gage height, in feet, of Yellowstone River at Junction, Mont., for 1907.

[J. E. Thurmond and Miss Nina Winter, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	.....	4.5	3.6	3.6	6.1	9.7	7.3	4.9	4.3	3.8	3.6
2	3.4	.....	4.5	3.7	3.7	6.8	9.5	7.0	4.8	4.2	3.7	3.6
3	3.45	.....	4.5	3.7	3.6	7.7	9.6	7.0	4.8	4.3	3.7	3.6
4	.....	.....	4.6	3.7	3.5	7.5	9.9	6.7	4.7	4.4	3.8	3.5
5	3.5	.....	4.7	3.7	3.5	7.2	10.6	6.7	4.7	4.3	3.8	3.5
6	.....	3.9	4.5	3.7	3.6	7.5	11.0	6.5	4.6	4.3	3.8	3.5
7	.....	.....	4.3	3.7	3.6	7.9	10.5	6.5	4.6	4.2	3.8	3.5
8	.....	.....	4.3	3.7	3.7	8.2	9.7	6.3	4.6	4.1	3.8	3.5
9	3.5	.....	4.5	3.8	3.7	8.6	9.6	6.2	4.7	4.1	3.7	3.5
10	.....	4.2	4.3	3.8	3.8	8.5	10.3	6.0	4.6	4.1	3.7	3.5
11	.....	4.4	4.1	3.8	4.0	7.9	9.7	6.0	4.5	4.1	3.7	3.5
12	.....	4.7	3.9	3.9	4.2	7.9	9.2	5.8	4.5	4.0	3.7	3.5
13	.....	4.8	3.9	3.9	4.5	8.2	9.1	5.8	4.5	4.0	3.6	3.5
14	.....	5.0	3.9	3.9	4.4	8.2	9.1	5.6	4.5	4.0	3.6	3.5
15	.....	5.6	3.8	4.0	4.2	7.8	9.1	5.6	4.5	4.0	3.6	.....
16	.....	6.0	3.8	4.0	4.1	7.6	9.4	5.4	4.4	4.0	3.7	.....
17	3.0	6.0	3.7	4.0	4.3	7.4	8.5	5.4	4.4	4.0	3.7	3.5
18	.....	5.8	3.7	4.0	5.6	7.4	8.1	5.2	4.3	3.9	3.7	3.5
19	.....	5.6	3.6	3.9	5.8	7.5	8.1	5.3	4.3	3.9	3.7	3.5
20	.....	5.4	3.6	3.9	6.0	7.6	8.4	5.1	4.2	3.9	3.7	3.5
21	.....	5.0	3.6	3.9	6.2	8.2	8.8	5.1	4.2	3.9	3.6	3.5
22	.....	4.8	3.55	3.8	6.4	8.6	8.7	4.9	4.1	3.9	3.6	3.5
23	.....	4.9	3.55	3.8	6.6	9.6	8.5	4.9	4.1	3.9	3.6	3.4
24	3.1	4.9	3.5	3.8	6.7	9.9	8.6	4.7	4.1	3.9	3.6	3.4
25	.....	4.8	3.5	3.7	6.9	8.9	8.4	4.8	4.0	3.9	3.6	3.4
26	.....	4.7	3.45	3.6	6.6	8.2	8.1	4.8	4.0	3.9	3.6	3.4
27	.....	4.5	3.45	3.6	6.3	7.2	7.8	5.0	4.1	3.9	3.6	3.4
28	.....	4.5	3.5	3.6	6.1	8.1	7.4	4.9	4.1	3.9	3.6	3.5
29	.....	.....	3.5	3.5	5.9	9.1	7.25	5.0	4.4	3.8	3.6	3.5
30	3.45	.....	3.5	3.5	5.9	9.4	7.5	5.0	4.4	3.8	3.6	3.5
31	.....	.....	3.5	.....	5.9	.....	7.4	5.0	.....	3.9	.....	.....

NOTE.—River frozen over January 3 to March 19. Above the gage the river was frozen entirely across, but below there was some open water because of rapids.
From January 3 to February 20 the river was frozen at the gage.

Rating table for Yellowstone River at Junction, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	2,740	4.80	8,390	6.20	16,240	8.20	28,840
3.50	3,060	4.90	8,890	6.30	16,850	8.40	30,180
3.60	3,390	5.00	9,400	6.40	17,460	8.60	31,520
3.70	3,730	5.10	9,910	6.50	18,080	8.80	32,860
3.80	4,080	5.20	10,430	6.60	18,700	9.00	34,200
3.90	4,440	5.30	10,960	6.70	19,320	9.20	35,600
4.00	4,820	5.40	11,500	6.80	19,940	9.40	37,000
4.10	5,220	5.50	12,050	6.90	20,570	9.60	38,400
4.20	5,640	5.60	12,620	7.00	21,200	9.80	39,800
4.30	6,060	5.70	13,210	7.20	22,460	10.00	41,200
4.40	6,500	5.80	13,810	7.40	23,720	11.00	48,400
4.50	6,960	5.90	14,410	7.60	24,980		
4.60	7,420	6.00	15,020	7.80	26,240		
4.70	7,900	6.10	15,630	8.00	27,500		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907, and is fairly well defined.

Monthly discharge of Yellowstone River at Junction, Mont., for 1907.

[Drainage area, 13,500 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Acre-feet.	
January			[a] 1,500	0.111	0.13	92,200	D.
March 19–31	3,390	2,900	3,140	.233	.11	81,000	B.
April	4,820	3,060	4,000	.296	.33	238,000	A.
May	20,600	3,060	9,800	.726	.84	603,000	A.
June	40,500	15,600	27,800	2.06	2.30	1,650,000	A.
July	48,400	22,800	34,400	2.56	2.95	2,120,000	A.
August	23,100	7,900	13,200	.978	1.13	812,000	A.
September	8,890	4,820	6,630	.490	.55	395,000	A.
October	6,500	4,080	4,930	.365	.42	303,000	A.
November	4,080	3,390	3,650	.270	.30	217,000	B.
December	3,390	2,740	3,040	.225	.26	187,000	C.
The period						6,700,000	

[a] Estimated.

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, which was established in 1893 by the United States War Department, was transferred to the Department of Agriculture, which has kept daily records of river height. When a study of the Lower Yellowstone Valley was begun in 1903 the station was taken up by the United States Geological Survey, whose records begin August 1, 1903. The station is located at the steel highway bridge leading northward from Glendive, about one-fourth mile from the post-office. The records are used to determine the amount of water available for the lower Yellowstone project and other irrigation enterprises. The drainage area of Yellowstone River at Glendive is 66,100 square miles.

The only large diversion from the Yellowstone near Glendive is the Lower Yellowstone canal, built by the United States Reclamation

PORTION OF COMPLETED MAIN CANAL, LOWER YELLOWSTONE PROJECT, MONTANA.

Service. It leaves the river 18 miles below Glendive and diverts water to irrigate 66,000 acres of land. (See Pl. VII.)

Since 1903 no change in gage datum has been made. The records obtained at this station are good during the open season. Although in low water the old piling and cribwork of a former bridge somewhat obstruct the flow. Ice exists from December to April.

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1907 and 1908.

[Howard Roby, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	7.75	1.75	2.0	5.8	9.0	7.35	3.9	2.6	1.9	1.4
2	.....	.....	7.3	1.9	1.9	5.8	9.15	7.25	3.9	2.6	1.9	1.3
3	.....	.....	6.95	2.0	1.9	5.85	9.4	6.95	3.95	2.75	1.8	1.3
4	.....	.....	6.65	1.9	1.8	6.2	9.4	6.85	3.95	2.8	1.8	1.4
5	.....	.....	6.7	1.85	1.8	7.2	9.65	6.65	3.7	2.8	1.8	1.4
6	.....	.....	6.45	1.75	1.8	7.3	9.95	6.6	3.55	2.9	1.8	1.2
7	.....	.....	6.55	1.7	1.75	7.2	10.3	6.7	3.45	2.7	1.75	1.15
8	.....	.....	6.9	1.7	1.7	7.8	10.7	6.3	3.35	2.6	1.7	1.2
9	.....	.....	6.8	1.6	1.7	8.6	10.5	6.15	3.3	2.5	.....	1.15
10	.....	.....	6.65	1.6	1.7	9.1	10.15	5.95	3.4	2.5	1.65	1.1
11	.....	.....	6.65	1.5	1.7	9.2	10.4	5.8	3.35	2.5	1.6	1.0
12	.....	.....	6.7	1.4	1.8	9.0	10.5	5.65	3.3	2.35	1.55	1.2
13	.....	.....	6.55	1.3	2.25	8.4	9.85	5.55	3.25	2.3	1.5	.....
14	.....	.....	6.4	1.3	2.75	8.2	9.4	5.45	3.2	2.3	1.45	.....
15	.....	.....	6.1	1.45	3.75	8.5	9.2	.....	3.2	2.3	1.4	.....
16	.....	.....	6.2	1.7	3.95	8.75	9.2	4.85	3.15	2.25	1.35	.....
17	.....	.....	6.0	1.7	3.6	8.2	9.4	4.75	3.05	2.3	1.3	.....
18	.....	.....	6.1	1.95	3.6	7.95	9.3	4.5	2.95	2.25	1.35	.....
19	.....	.....	6.2	2.3	3.55	7.55	8.4	4.4	2.85	2.1	1.4	.....
20	.....	8.7	6.15	2.4	4.6	7.1	7.95	4.25	2.85	2.1	1.5	.....
21	.....	8.55	6.7	2.4	5.05	7.3	8.4	4.2	3.0	2.1	1.5	.....
22	.....	7.9	7.45	2.3	5.45	8.0	8.15	4.15	3.05	2.05	1.5	.....
23	.....	7.85	7.05	2.25	6.05	9.5	8.25	4.05	3.3	2.0	1.5	.....
24	.....	7.8	3.6	2.1	6.75	10.9	8.1	3.9	3.3	2.0	1.4	.....
25	.....	8.7	3.3	1.95	8.2	10.8	8.1	3.8	2.85	2.0	1.4	.....
26	.....	8.35	2.9	1.9	9.1	10.15	8.05	3.7	2.55	2.0	1.4	.....
27	.....	8.05	2.8	1.95	8.9	8.85	7.8	3.6	2.5	1.9	1.35	.....
28	.....	8.0	2.55	2.0	8.2	8.2	7.5	4.05	2.4	1.9	1.3	.....
29	.....	.....	2.25	2.05	7.25	7.45	7.4	4.4	2.4	1.9	1.3	.....
30	.....	.....	2.15	2.05	6.5	8.15	7.15	4.05	2.4	1.9	1.4	.....
31	.....	.....	1.95	.....	6.0	.....	7.15	3.95	.....	1.9	.....	.....
1908.												
1	.....	2.6	.....	.....	2.75	7.05	8.1	5.2	3.25	2.3	2.3	6.0
2	.....	.....	.....	.....	2.55	7.7	7.7	5.05	3.2	2.2	2.3	5.8
3	.....	.....	.....	.....	2.4	8.35	8.0	4.85	3.05	2.3	2.25	6.25
4	4.9	2.3	.....	.....	2.3	9.7	8.3	4.75	3.0	2.55	2.2	5.6
5	.....	.....	.....	.....	2.2	10.0	8.45	4.6	2.9	2.9	2.15	5.8
6	.....	.....	.....	.....	2.5	9.2	8.75	4.55	2.8	3.25	2.1	5.7
7	.....	.....	.....	.....	2.95	8.6	9.25	4.35	2.7	3.0	2.1	6.13
8	.....	.....	.....	1.45	3.05	8.15	9.3	4.2	2.55	3.0	.....	6.3
9	.....	.....	3.8	1.4	3.1	7.6	8.5	4.1	2.4	2.95	2.0	.....
10	.....	.....	.....	1.25	3.75	7.45	8.35	3.95	2.3	2.8	2.0	.....
11	4.9	.....	.....	1.1	4.55	8.05	8.35	3.8	2.3	2.7	2.2	.....
12	.....	.....	4.55	1.0	4.95	8.35	8.4	3.7	2.3	2.6	2.3	.8
13	.....	.....	.....	.9	4.95	8.55	8.45	3.7	2.2	2.6	2.0	.....
14	4.6	.....	5.6	.9	4.7	8.75	8.25	3.85	2.2	2.5	1.65	.....
15	.....	.....	.....	1.0	4.4	9.35	8.1	3.9	2.2	2.5	1.5	.....
16	.....	.....	.....	1.15	4.15	9.75	8.1	3.95	2.1	2.55	.6	7.8
17	.....	.....	.....	1.35	4.05	10.2	8.0	3.9	2.15	2.8	.9	.....
18	3.6	.....	5.4	1.7	4.0	10.6	7.6	4.25	2.3	2.75	1.55	.....
19	.....	.....	.....	2.0	4.0	10.5	7.4	4.35	2.3	2.9	.....	6.5
20	.....	.....	5.8	2.15	.....	10.35	6.95	4.3	2.25	3.2	.....	.....
21	3.9	.....	.....	2.35	4.15	9.85	6.6	4.0	2.45	3.15	.....	.....
22	.....	.....	.....	2.55	5.1	9.25	6.25	4.35	2.3	2.95	.....	.....
23	.....	.....	6.05	2.8	6.2	8.55	6.1	4.45	2.2	2.8	1.8	6.3
24	.....	.....	.....	3.05	6.95	7.9	6.05	4.15	2.1	2.65	2.0	.....
25	4.1	.....	.....	3.9	6.75	7.85	5.9	4.1	2.05	2.55	2.25	.....

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
26	.....	.....	.....	4.0	6.85	7.6	5.9	4.0	2.1	2.5	2.2	6.4
27	.....	.....	.....	3.95	6.65	7.35	5.8	4.0	2.2	2.5	2.25	.....
28	3.7	.....	.....	3.7	5.9	7.75	5.65	3.95	2.2	2.5	2.25	.....
29	.....	.....	4.2	3.35	7.8	8.5	5.55	3.75	2.2	2.4	2.3	.....
30	.....	.....	.....	3.05	7.9	8.85	5.7	3.55	2.25	2.35	1.85	6.6
31	.....	.....	.....	.....	7.1	.....	5.25	3.35	.....	2.3	.....	.....

NOTE.—Ice conditions January 1 to March 23, December 13 to 31, 1907. River frozen entirely across with no anchor ice January 1 to February 13, 1907; ice broke up and went out February 14 to 19. February 25 to March 23, 1907, ice jam at gage; gage reading to top of ice; ice went out March 23.
Ice conditions January 1 to April 7, December 1 to 31, 1908; gage readings are to water surface.

Rating table for Yellowstone River at Glendive, Mont., for 1906 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	4,640	2.20	7,860	3.50	12,900	5.60	25,900
1.00	4,860	2.30	8,160	3.60	13,380	5.80	27,500
1.10	5,080	2.40	8,480	3.70	13,860	6.00	29,200
1.20	5,300	2.50	8,820	3.80	14,360	6.20	31,000
1.30	5,530	2.60	9,180	3.90	14,880	6.40	32,900
1.40	5,760	2.70	9,540	4.00	15,400	6.60	34,900
1.50	5,990	2.80	9,920	4.20	16,500	6.80	37,000
1.60	6,240	2.90	10,300	4.40	17,650	7.00	39,200
1.70	6,490	3.00	10,700	4.60	18,850	8.00	50,900
1.80	6,740	3.10	11,120	4.80	20,150	9.00	64,000
1.90	7,020	3.20	11,540	5.00	21,500	10.00	78,000
2.00	7,300	3.30	11,980	5.20	22,900	11.00	92,000
2.10	7,580	3.40	12,440	5.40	24,300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1906, and is well defined between gage heights 1.3 feet and 8.0 feet. Below gage height 2.4 feet it is the same as the 1905 table.

Monthly discharge of Yellowstone River at Glendive, Mont., for 1907 and 1908.

[Drainage area, 66,100 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 24–31	13,400	7,160	9,680	0.146	0.04	154,000	A.
April	8,480	5,530	6,940	.105	.12	413,000	A.
May	65,400	6,490	20,600	.312	.36	1,270,000	A.
June	90,600	27,500	53,200	.805	.90	3,170,000	A.
July	87,800	40,800	64,000	.968	1.12	3,940,000	B.
August	43,100	13,400	24,100	.365	.42	1,480,000	A.
September	15,100	8,480	11,600	.175	.20	690,000	A.
October	10,300	7,020	8,220	.124	.14	505,000	A.
November	7,020	5,530	6,100	.092	.10	363,000	B.
December 1–12	5,760	4,860	5,380	.081	.04	128,000	B.
The period	.....	.....	.....	.....	.....	12,100,000	
1908.							
April 8–30	15,400	4,640	8,440	.128	.11	385,000	A.
May	49,700	7,860	21,300	.322	.37	1,310,000	A.
June	86,400	39,800	60,800	.920	1.03	3,620,000	B.
July	68,200	23,200	44,800	.678	.78	2,750,000	A.
August	22,900	12,200	16,400	.248	.29	1,010,000	A.
September	11,800	7,440	8,620	.130	.14	513,000	A.
October	11,800	7,860	9,500	.144	.17	584,000	A.
November 1–10	8,160	7,300	7,710	.117	.04	153,000	B.
The period	.....	.....	.....	.....	.....	10,300,000	

NORTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, is located 1 mile above the Tintinger ranch, 15 miles northwest of Big Timber, just above the junction with the South Fork.

The source of North Fork is two lakes in the Crazy Mountains. These lakes form excellent reservoir sites. It is proposed to utilize the flow of the North Fork in connection with a project under the Carey land act. The drainage area above the station is only 40 square miles.

Several ditches above the station divert water to irrigate approximately 300 acres of land. A large ditch appropriating 50,000 inches of water has its head-gate just below the gage. This appropriation includes both forks. The water rights on Big Timber Creek have never been adjudicated.

At the gaging station the bed of the stream is composed of bowlders and coarse gravel, and is probably permanent. Results obtained during the open season are good.

Discharge measurements of North Fork of Big Timber River near Big Timber, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Robert Follansbee	30	23.8	1.10	30.9
May 31	do	37	43.6	1.75	118
September 27	J. E. Stewart	24	20.2	.94	21.5
1908.					
May 13	Raymond Richards	24	19.9	1.28	33.8
May 25	J. E. Stewart	37.5	31.7	1.37	47.6
July 24	Raymond Richards	38	36.8	1.70	90.3
October 7	J. E. Stewart	19	13.4	1.18	27.2

Daily gage height, in feet, of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1				2.12	2.35	1.78	1.11	1.05	0.85
2				2.22	2.40	1.78	1.11	1.00	.85
3				2.18	2.45	1.82	1.11	1.15	.85
4				1.92	2.60	1.72	1.11	1.05	.85
5				2.00	2.45	1.65	1.11	1.00	.85
6				2.28	2.35	1.60	1.11	1.00	.85
7			1.30	2.32	2.15	1.60	1.11	.90	.85
8			1.32	2.18	2.30	1.60	1.10	.90	.85
9			1.32	1.98	2.30	1.62	1.15	.90	.85
10			1.30	1.92	2.10	1.95	1.10	.90	
11			1.42	1.65	2.05	1.75	1.10	.90	
12			1.57	1.90	2.05	1.65	1.05	.90	
13			1.45	2.08	2.30	1.65	1.05	.90	
14			1.35	2.18	2.35	1.68	1.05	.90	
15			1.41	2.00	2.30	1.65	1.00	.90	

Daily gage height, in feet, of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
16			1.50	1.78	2.28	1.45	1.00	.90	
17			1.90	1.82	2.20	1.45	1.00	.85	
18			1.98	2.00	2.10	1.38	.92	.85	
19			2.30	2.45	2.05	1.32	.92	.85	
20			2.62	2.48	2.38	1.28	.90	.85	
21			2.42	2.35	2.30	1.22	.90	.85	
22			2.05	2.28	2.25	1.22	.90	.85	
23			1.70	2.45	2.05	1.22	.90	.85	
24			1.68	2.15	1.98	1.22	.90	.85	
25			1.58	2.10	1.92	1.18	.90	.85	
26			1.60	2.00	1.90	1.18	.90	.85	
27			1.60	2.35	1.95	1.18	.90	.85	
28			1.60	2.65	1.95	1.18	.90	.85	
29			1.72	2.68	2.00	1.18	1.05	.85	
30			1.72	2.50	2.05	1.16	1.00	.85	
31			1.90		1.82	1.15		.85	
1908.									
1		0.90	1.20	4.05	2.00	1.53	1.10	1.15	
2		.88	1.20	3.85	1.90	1.50	1.10	1.15	
3		.80	1.25	3.85	2.25	1.50	1.10	1.15	
4		.80	1.32	3.70	2.30	1.50	1.10	1.10	
5		.85	1.35	3.10	2.25	1.50	1.10	1.10	
6		.90	1.38	3.10	2.00	1.50	1.10	1.10	
7		.90	1.45	3.10	1.85	1.45	1.10	1.05	
8		.90	1.75	3.05	2.35	1.45	1.10	1.05	
9		.90	1.80	3.15	2.35	1.45	1.10	1.05	
10		.95	1.70	3.40	2.25	1.50	1.10	1.05	
11		.92	1.30	3.00	2.00	1.50	1.10	1.05	
12		.95	1.30	2.85	1.85	1.60	1.10	1.05	
13		1.00	1.30	2.85	2.30	1.65	1.10	1.05	
14		1.05	1.28	2.85	1.80	1.65	1.10	1.05	
15		.95	1.30	2.75	1.75	1.60	1.10	1.20	
16		1.02	1.30	3.00	1.60	1.60	1.10	1.25	
17		1.10	1.30	2.75	1.70	1.55	1.10	1.25	
18		1.10	1.25	2.50	1.65	1.60	1.10	1.25	
19		1.20	1.30	2.45	1.65	1.60	1.10	1.25	
20		1.32	1.25	2.00	1.70	1.60	1.10	1.20	
21		1.40	1.35	1.80	1.70	1.55	1.10	1.20	
22	0.80	1.42	1.35	1.75	1.70	1.55	1.10	1.15	
23	.75	1.32	1.35	1.75	1.70	1.45	1.10	1.25	
24	.75	1.32	1.40	1.80	1.65	1.25	1.10	1.25	
25	.78	1.17	1.50	1.90	1.65	1.25	1.15		
26	.75	1.10	2.00	1.80	1.70	1.20	1.15		
27	.88	1.12	2.40	1.75	1.65	1.15	1.15		
28	.80	1.10	2.20	1.60	1.70	1.10	1.10		
29	.80	1.12	1.85	1.50	1.65	1.10	1.10		
30	.88	1.20	1.85	1.55	1.60	1.00	1.10		
31	.90		2.00		1.55	1.15			

Rating tables for North Fork of Big Timber River near Big Timber, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	19	1.40	59	1.90	155	2.40	309
1.00	24	1.50	72	2.00	182	2.50	344
1.10	30	1.60	88	2.10	211	2.60	380
1.20	38	1.70	107	2.20	242	2.70	416
1.30	48	1.80	130	2.30	275		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and the form of the subsequent curve. It is not well defined.

Rating tables for North Fork of Big Timber River near Big Timber, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	10	1.60	73	2.50	314	3.40	650
.80	12	1.70	90	2.60	350	3.50	688
.90	15	1.80	110	2.70	386	3.60	726
1.00	19	1.90	133	2.80	423	3.70	764
1.10	24	2.00	158	2.90	460	3.80	802
1.20	30	2.10	185	3.00	498	3.90	840
1.30	37	2.20	214	3.10	536	4.00	878
1.40	46	2.30	245	3.20	574	4.10	916
1.50	58	2.40	278	3.30	612		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on ten discharge measurements made during 1908–9, and is well defined between gage heights 0.75 foot and 2.1 feet Above gage height 2.1 feet it has been extended and is only approximate.

Monthly discharge of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908.

Month	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 7–31	387	48	121	6,000	A.
June	409	97	236	14,000	A.
July	380	135	240	14,800	A.
August	168	34	74.9	4,610	A.
September	34	19	25.2	1,500	B.
October	34	18	20.0	1,230	C.
November 1–9	18	18	18.0	321	C.
The period				42,500	
1908.					
March 22–31	15	11	12.4	246	C.
April	48	12	23.3	1,390	A.
May	278	30	71.5	4,400	A.
June	897	58	383	22,800	B.
July	262	66	132	8,120	A.
August	82	19	54.7	3,360	A.
September	27	24	24.3	1,450	B.
October 1–24	34	22	27.1	1,290	B.
The period				43,100	

SOUTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, to determine the amount of water available for irrigation in connection with a Carey Land Act project, is located 1 mile above Tintinger's ranch, 15 miles northwest of Big Timber. The station is just above the junction with the North Fork.

The drainage area above the station is about 10 square miles. A few diversions are made, and practically all the water is appropriated.

Ice forms during the winter months. The channel is practically permanent and fairly good results have been obtained during the open season.

Discharge measurements of South Fork of Big Timber Creek near Big Timber, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Robert Follansbee	24	13.0	0.52	17.1
May 31	do	27	24.4	.95	73.1
September 27	J. E. Stewart	14	9.7	.59	18.2
1908.					
May 13	Raymond Richards	22	14.8	.70	25.4
May 25	J. E. Stewart	24	17.2	.80	42.5
July 24	Raymond Richards	21.5	18.5	.89	30.0
October 7	J. E. Stewart	13	8.75	.51	10.4

NOTE.—These measurements were made by wading at different sections.

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1				1.18	1.30	1.02	0.55	0.40	0.35
2				1.25	1.35	.95	.55	.60	.35
3				1.20	1.40	1.00	.55	.60	.35
4				.98	1.52	1.10	.55	.60	.35
5				.98	1.45	1.05	.55	.58	.35
6				1.25	1.35	1.05	.55	.58	.35
7			0.35	1.40	1.25	1.05	.55	.50	.35
8			.36	1.32	1.35	1.02	.50	.40	.35
9			.37	1.00	1.45	1.00	.50	.40	.35
10			.40	.92	1.20	1.35	.50	.40	
11			.85	.95	1.08	1.15	.45	.40	
12			.78	.98	1.15	.98	.45	.40	
13			.70	1.20	1.80	.90	.45	.40	
14			.60	1.22	1.30	.85	.38	.40	
15			.52	1.18	1.22	.82	.35	.40	
16			.58	.80	1.32	.78	.32	.35	
17			.90	.78	1.45	.80	.30	.35	
18			.94	.92	1.40	.80	.28	.35	
19			1.02	1.40	1.35	.75	.28	.35	
20			1.15	1.42	1.32	.70	.25	.35	
21			.98	1.40	1.70	.70	.20	.35	
22			.98	1.28	1.35	.70	.20	.35	
23			1.00	1.45	1.40	.70	.20	.35	
24			.90	1.25	1.30	.65	.20	.35	
25			.90	1.15	1.28	.65	.20	.35	
26			.90	1.25	1.20	.65	.20	.35	
27			.90	1.35	1.20	.65	.55	.35	
28			.90	1.65	1.30	.70	.60	.35	
29			.92	1.65	1.40	.65	.40	.35	
30			.95	1.45	1.35	.65	.40	.35	
31			1.02		1.10	.55		.35	
1908.									
1		0.40	.60	2.50	1.10	.75	.45	.60	
2		.38	.60	2.45	.85	.75	.50	.60	
3		.35	.65	2.45	1.50	.75	.50	.60	
4		.35	.65	2.35	1.50	.70	.50	.55	
5		.35	.70	2.45	1.75	.70	.50	.55	
6		.40	.72	2.45	1.60	.70	.50	.55	
7		.40	.75	2.30	1.45	.70	.45	.52	
8		.40	.85	2.25	1.75	.70	.45	.52	
9		.40	.90	2.30	1.75	.70	.45	.52	
10		.40	.80	2.40	1.75	.70	.45	.52	
11		.45	.65	2.35	1.60	.70	.45	.50	
12		.45	.65	2.25	1.45	.75	.45	.52	
13		.50	.60	2.20	1.60	.80	.50	.50	
14		.50	.70	2.25	1.45	.80	.55	.50	
15		.45	.50	2.10	1.35	.75	.55	.50	
16		.50	.40	2.10	1.30	.75	.55	.60	
17		.50	.40	1.85	1.25	.65	.55	.60	
18		.55	.30	1.90	1.30	.65	.55	.60	
19		.62	.30	1.80	1.30	.65	.55	.60	
20		.68	.35	1.50	1.25	.55	.55	.55	

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
21	.....	.75	.35	1.40	1.00	.45	.55	.55	.....
22	0.30	.80	.30	1.35	1.00	.40	.55	.55	.....
23	.25	.72	.30	1.15	1.00	.35	.55	.60	.....
24	.25	.72	.35	1.10	.95	.35	.55	.60	.....
25	.28	.62	.45	1.15	.90	.45	.60	.....	.....
26	.25	.60	.85	1.10	.85	.35	.60	.....	.....
27	.25	.60	1.20	1.10	.85	.35	.60	.....	.....
28	.25	.55	1.10	1.00	.85	.35	.60	.....	.....
29	.25	.52	1.10	.85	.80	.30	.55	.....	.....
30	.32	.58	1.05	.75	.80	.30	.55	.....	.....
31	.35	.....	1.05	.....	.80	.45	.....	.....	.....

Rating tables for South Fork of Big Timber Creek near Big Timber, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	2	0.70	31	1.20	140	1.70	305
.30	4	.80	44	1.30	171	1.80	340
.40	8	.90	62	1.40	203		
.50	13	1.00	85	1.50	236		
.60	21	1.10	111	1.60	270		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on three discharge measurements made during 1907 and is not well defined.

FOR 1908.

0.30	3	0.90	48	1.50	212	2.10	412
.40	6	1.00	68	1.60	244	2.20	446
.50	10	1.10	92	1.70	277	2.30	480
.60	15	1.20	119	1.80	310	2.40	515
.70	23	1.30	149	1.90	344	2.50	550
.80	33	1.40	180	2.00	378		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on ten discharge measurements made during 1908–9, and is well defined below gage height 1.1 feet. Above this the table is only approximate.

Monthly discharge of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 7–31	125	6	53.6	2,660	B.
June	287	41	147	8,750	B.
July	340	106	185	11,400	B.
August	187	17	60.5	3,720	B.
September	21	2	9.6	571	C.
October	21	6	9.1	560	C.
November 1–9	6	6	6.0	107	C.
1908.					
March 22–31	4	2	2.6	52	C.
April	33	4	12.1	720	B.
May	119	3	29.0	1,780	A.
June	550	28	332	19,800	B.
July	294	33	144	8,850	A.
August	33	3	17.5	1,080	A.
September	15	8	11.1	660	B.
October 1–24	15	10	12.6	600	B.
The period	.....	.....	.....	33,500	

EAST FORK OF BOULDER RIVER NEAR M'LEOD, MONT.

This station, which was established August 13, 1907, to determine the value of the stream for power and irrigation, is located at the first highway bridge over the East Boulder, 4 miles from McLeod. The station is 1 mile above the mouth.

This fork, which drains a valley of well-irrigated land, has no important tributaries. Several ditches receive their water from the East Boulder.

The bed of the stream is composed of coarse gravel and bowlders and should be permanent, but the swiftness of the current at high stages and the rough rocky bed make it difficult to obtain good results. This stream freezes over during the winter months. No change in gage datum has been made.

Discharge measurements of East Fork of Boulder River near McLeod, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 13[a]	J. E. Stewart	35	39.5	0.50	89
September 28[a]	do	24	25.6	.33	41.8
1908.					
May 11[a]	Raymond Richards	26.5	34.8	.49	86.5
June 9	do	52.5	72.1	1.10	379
July 25[a]	do	35	40.3	.55	121
October 9[a]	J. E. Stewart	24	23.4	.22	40.2

[a] Made by wading.

Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908.

[E. C. McConnell, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1	.....	0.38	0.35	0.28	0.20	16	0.42	0.30	0.30	0.20	.....
2	.....	.35	.35	.25	.20	17	.40	.30	.25	.20	.....
3	.....	.35	.35	.25	.15	18	.40	.30	.25	.20	.....
4	.....	.35	.35	.25	.15	19	.42	.30	.25	.20	.....
5	.....	.32	.32	.25	.15	20	.40	.30	.25	.20	.....
6	.....	.32	.30	.25	.15	21	.40	.30	.25	.20	.....
7	.....	.35	.30	.25	.15	22	.40	.30	.25	.20	.....
8	.....	.30	.30	.25	.15	23	.38	.30	.25	.20	.....
9	.....	.30	.30	.25	.15	24	.35	.30	.25	.20	.....
10	.....	.30	.30	.20	.15	25	.32	.30	.25	.20	.....
11	.....	.32	.30	.20	.15	26	.35	.30	.25	.20	.....
12	.....	.35	.30	.20	.15	27	.35	.35	.25	.20	.....
13	0.5	.35	.30	.20	.15	28	.38	.35	.25	.20	.....
14	.48	.35	.30	.20	.15	29	.35	.35	.25	.20	.....
15	.45	.35	.30	.20	.15	30	.38	.35	.25	.15	.....
						31	.38	.....	.30	.....	.....

Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	0.12	0.05	0.15	1.25	1.8	0.40	0.20	0.20	0.20
2	.10	.08	.20	1.15	1.6	.38	.20	.18	.20
3	.12	.08	.20	1.15	1.7	.32	.20	.20	.20
4	.12	.05	.30	1.05	1.35	.30	.20	.20	.20
5	.12	.05	.28	.95	1.15	.30	.20	.20	.20
6	.10	.05	.45	.85	1.05	.30	.20	.20	.20
7	.10	.05	.68	.85	1.05	.30	.18	.20	.20
8	.10	.05	.70	.90	1.15	.25	.18	.20	.20
9	.10	.05	.65	1.05	1.10	.25	.15	.20	.20
10	.10	.05	.55	1.10	1.00	.20	.15	.20	.18
11	.12	.05	.48	1.20	.95	.20	.15	.20	.18
12	.10	.05	.45	1.60	.95	.22	.15	.20	.20
13	.08	.05	.40	1.65	.90	.22	.15	.20	.20
14	.10	.05	.38	1.70	.90	.28	.15	.20	.15
15	.10	.05	.35	1.80	.85	.25	.15	.28	.15
16	.10	.05	.45	1.65	.80	.25	.15	.25	.15
17	.10	.05	.45	1.45	.72	.25	.15	.25	.15
18	.12	.10	.40	1.30	.68	.25	.15	.20	.15
19	.10	.12	.42	1.10	.68	.25	.15	.20	.15
20	.10	.28	.50	1.05	.65	.25	.15	.20	.15
21	.08	.45	.45	1.00	.60	.25	.15	.18	.15
22	.10	.50	.50	.90	.58	.25	.15	.20	.15
23	.05	.50	.52	.82	.60	.25	.15	.20	.15
24	.10	.35	.55	.95	.62	.25	.15	.20	.15
25	.10	.30	.58	1.45	.55	.25	.15	.20	.15
26	.10	.25	.70	1.85	.55	.25	.10	.20	.10
27	.10	.20	.75	1.50	.55	.22	.15	.20	.12
28	.08	.20	.85	1.05	.52	.20	.15	.20	.10
29	.08	.15	.80	1.15	.52	.20	.18	.20	.12
30	.08	.18	.85	1.35	.50	.20	.18	.20	.10
31	.05	.....	1.10	.....	.45	.20	.....	.20	.....

NOTE.—Ice conditions December 16–31, 1907.

Rating tables for East Fork of Boulder River near McLeod, Mont.

AUGUST 13, 1907, TO JUNE 26, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	3	0.50	89	1.00	315	1.50	645
.10	10	.60	122	1.10	375	1.60	720
.20	21	.70	160	1.20	440	1.70	795
.30	36	.80	205	1.30	505	1.80	870
.40	60	.90	257	1.40	575		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is fairly well defined below gage height 1.2 feet.

JUNE 27 TO NOVEMBER 30, 1908.

0.00	11	0.50	104	1.00	330	1.50	650
.10	23	.60	139	1.10	390	1.60	720
.20	38	.70	180	1.20	450	1.70	790
.30	56	.80	225	1.30	510	1.80	860
.40	77	.90	275	1.40	580		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and on the form of the previous curve. It is fairly well defined.

Monthly discharge of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy
	Maximum.	Minimum.	Mean.		
1907.					
August 13–31	89	41	59.5	2,240	B.
September	55	36	41.9	2,490	B.
October	48	28	34.1	2,100	B.
November	33	16	23.1	1,370	C.
December 1–15	21	16	16.7	497	C.
1908.					
March	12	6	9.97	613	D.
April	89	6	20.1	1,200	C.
May	375	16	107	6,580	B.
June	908	215	470	28,000	B.
July	860	90	286	17,600	A.
August	77	38	47.7	2,930	A.
September	38	23	32.0	1,900	B.
October	51	35	38.7	2,380	B.
November	38	23	32.3	1,920	B.
The period				63,100	

WEST FORK OF BOULDER RIVER NEAR BRUFFEYS, MONT.

This station, which is located at the highway bridge on the Livingston road about 7 miles from Bruffeys and 30 miles from Big Timber, was established May 7, 1904, by the state engineer of Montana, for the purpose of obtaining data in connection with irrigation projects. On May 4, 1907, it was transferred to the United States Geological Survey.

West Fork receives numerous small tributaries which enter from both sides above the station, the largest being Davis Creek, which comes in from the west 1½ miles upstream. One small irrigation ditch above the station diverts 3 or 4 second-feet of water. The drainage area is 94 square miles.

The channel is composed of small bowlders and coarse gravel and is reasonably permanent. The gage datum has remained unchanged since the station was established and the results obtained are excellent for the entire open season. At times during the winter this stream is open, but during the greater part of this period the gage heights are affected by ice.

The gage heights from 1904 to May 2, 1907 were furnished by J. W. Wade, state engineer of Montana.

Discharge measurements of West Fork of Boulder River near Bruffeys, Mont., in 1904, 1907, and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	J. S. Baker			2.00	258
May 18	do			2.18	318
November 17	do			1.18	36
1907.					
May 3 [a]	Robert Follansbee	63	57	1.38	64
May 28	do	75	110	1.93	212
June 10	do	78	173	2.80	618
July 2	Follansbee and Stewart	78	227	3.42	1,180
September 28 [a]	J. E. Stewart	60	70	1.53	96
1908.					
October 8 [a]	J. E. Stewart	57	57.2	1.38	65.6

[a] Made by wading.

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908.

[George Knight, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.[a]												
1						3.18	3.60	2.10	1.55	1.40	1.40	1.30
2						2.98	3.38	2.10	1.70	1.40	1.40	1.30
3						2.78	3.45	2.08	1.70	1.40	1.35	1.35
4						2.58	3.40	2.02	1.70	1.45	1.30	1.45
5						2.52	3.30	2.05	1.65	1.50	1.30	1.50
6						2.78	3.18	2.00	1.65	1.40	1.30	1.50
7						3.08	3.05	2.00	1.60	1.40	1.30	1.50
8						2.82	3.08	2.05	1.60	1.45	1.30	1.50
9						3.15	3.02	1.92	1.60	1.45	1.20	1.50
10						3.38	2.95	1.95	1.70	1.40	1.20	1.50
11						3.25	3.05	2.32	1.70	1.40	1.20	1.50
12						3.02	2.95	2.15	1.70	1.40	1.20	1.50
13						3.18	2.80	2.00	1.60	1.40	1.25	1.50
14						3.32	3.02	1.95	1.60	1.40	1.20	1.60
15						3.45	2.82	1.98	1.70	1.40	1.20	1.60
16						3.60	2.75	1.88	1.60	1.40	1.20	1.60
17					2.00	3.82	2.55	1.85	1.60	1.40	1.20	1.60
18					2.19	3.92	2.48	1.88	1.60	1.40	1.20	1.60
19					2.50	3.70	2.48	1.82	1.60	1.40	1.20	1.60
20					2.90	3.60	2.48	1.75	1.50	1.40	1.20	1.60
21					2.90	3.68	2.62	1.70	1.50	1.40	1.20	1.70
22					3.15	3.60	2.60	1.65	1.45	1.50	1.20	1.70
23					3.20	3.52	2.68	1.70	1.40	1.40	1.20	1.80
24					3.15	3.10	2.65	1.70	1.45	1.40	1.20	1.75
25					2.70	2.65	2.55	1.70	1.45	1.40	1.20	1.35
26					2.50	2.60	2.42	1.65	1.40	1.45	1.25	1.45
27					2.40	2.70	2.35	1.55	1.45	1.45	1.25	1.60
28					2.50	2.90	2.45	1.70	1.50	1.40	1.20	1.50
29					2.60	3.22	2.45	1.70	1.50	1.40	1.20	1.55
30					2.90	3.52	2.30	1.70	1.45	1.40	1.20	1.50
31					3.10		2.08	1.65		1.40		1.55
1905.[b]												
1	1.45		1.1				2.95	1.9	1.5	1.4	1.3	1.2
2	1.5		1.1				2.95	1.85	1.5	1.4	1.25	1.2
3	1.45		1.1				2.95	1.9	1.4	1.4	1.2	1.2
4	1.5		1.1			3.15	2.85	1.75	1.45	1.3	1.2	1.2
5	1.45		1.1			3.45	2.85	1.7	1.45	1.3	1.2	1.2
6	1.55		1.15			3.15	2.9	1.65	1.4	1.3	1.2	1.25
7	1.6		1.15			3.15	2.9	1.55	1.4	1.4	1.2	1.2
8	1.5		1.1			3.45	2.75	1.45	1.3	1.4	1.2	1.2
9	1.45		1.2			3.4	2.75	1.25	1.3	1.4	1.2	1.2
10	1.5		1.15			3.9	2.8	1.05	1.3	1.4	1.2	1.2

[a] Probable ice conditions during December, 1904.
[b] Probable ice conditions January, February, and December, 1905. Ice jams December 22 and 25, 1905.

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.[a]												
11	1.35	.....	1.1	.....	.....	.....	2.85	1.05	1.3	1.45	1.2	1.2
12	1.35	.....	1.15	.....	.....	.....	2.75	1.1	1.3	1.4	1.2	1.2
13	.....	.....	1.1	.....	.....	.....	2.65	1.05	1.3	1.4	1.2	1.2
14	.....	.....	1.15	.....	.....	.....	2.65	1.05	1.2	1.4	1.2	1.2
15	.....	.....	1.1	.....	.....	.....	2.6	1.0	1.2	1.4	1.2	1.2
16	.....	.....	1.1	.....	.....	.....	2.55	1.0	1.2	1.4	1.2	1.2
17	.....	.....	1.1	.....	.....	.....	2.35	1.40	1.2	1.3	1.2	1.2
18	.....	.....	1.1	.....	.....	2.4	2.35	1.45	1.2	1.3	1.2	1.2
19	.....	.....	1.1	.....	.....	2.5	2.3	1.35	1.2	1.3	1.2	1.2
20	.....	.....	1.15	.....	.....	2.4	2.3	1.5	1.2	1.3	1.2	1.2
21	.....	.....	1.1	.....	.....	2.5	2.3	1.5	1.2	1.35	1.2	1.2
22	1.2	.....	1.1	.....	.....	3.0	2.25	1.5	1.2	1.35	1.2	1.45
23	1.2	.....	1.1	.....	.....	2.8	2.1	1.45	1.2	1.3	1.2	1.25
24	1.2	.....	1.1	.....	.....	2.8	2.05	1.5	1.2	1.3	1.2	1.2
25	1.1	1.1	1.15	.....	.....	2.85	2.05	1.5	1.35	1.3	1.2	1.45
26	1.1	1.1	1.1	.....	.....	2.65	2.0	1.5	1.4	1.3	1.2	1.45
27	1.2	1.1	1.1	.....	.....	3.3	2.0	1.5	1.4	1.2	1.2	1.3
28	1.1	1.15	1.1	.....	.....	3.15	2.05	1.5	1.35	1.2	1.2	1.3
29	1.1	.....	1.1	.....	.....	3.15	2.1	1.5	1.4	1.2	1.2	1.45
30	1.35	.....	1.1	.....	.....	2.95	1.95	1.5	1.4	1.2	1.2	1.45
31	.....	.....	1.1	.....	.....	.....	1.95	1.5	.....	1.3	.....	1.5
1906.[b]												
1	1.5	1.1	1.35	1.1	1.85	2.1	3.05	.....	.....	.....	1.3	1.5
2	1.5	1.1	1.35	1.1	1.65	2.15	2.75	.....	.....	.....	1.3	1.4
3	1.6	1.1	1.25	1.1	1.85	2.55	2.65	.....	.....	.....	1.3	1.4
4	1.6	1.1	1.2	1.1	1.65	2.55	2.75	.....	.....	.....	1.4	1.3
5	1.65	1.1	1.25	1.1	1.75	2.65	2.75	.....	.....	.....	1.35	1.3
6	1.7	1.1	1.3	1.15	1.85	2.65	2.65	.....	.....	.....	1.3	1.3
7	1.7	1.2	1.3	1.3	1.85	2.75	2.55	.....	.....	.....	1.3	1.3
8	1.65	1.2	1.3	1.25	1.85	2.75	2.65	.....	.....	.....	1.3	1.3
9	1.6	1.3	1.3	1.2	1.85	2.85	2.65	.....	.....	.....	1.3	1.3
10	1.5	1.3	1.2	1.25	2.55	3.05	2.65	.....	.....	.....	1.4	1.3
11	1.5	1.2	.....	1.3	2.25	3.1	2.65	.....	.....	.....	1.3	1.3
12	1.55	1.2	.....	1.2	2.25	3.55	2.65	.....	.....	.....	1.3	1.3
13	1.55	1.2	.....	1.3	2.4	3.45	3.0	.....	.....	.....	1.3	1.3
14	1.5	1.2	.....	1.35	2.55	3.45	.....	.....	.....	1.3	1.3	1.3
15	1.5	1.25	.....	1.3	2.45	3.55	.....	.....	.....	1.3	1.3	1.3
16	1.5	1.3	.....	1.45	2.55	3.45	.....	.....	.....	1.4	1.3	1.3
17	1.55	1.3	.....	1.35	2.55	3.45	.....	.....	.....	1.4	1.3	1.25
18	1.5	1.3	.....	1.35	2.5	3.35	.....	.....	.....	1.4	1.3	1.3
19	1.45	1.3	.....	1.45	2.15	3.25	.....	.....	.....	1.4	1.3	1.3
20	1.5	1.3	.....	1.55	2.2	3.05	.....	.....	.....	1.4	1.3	1.2
21	1.5	1.25	.....	1.55	2.25	3.15	.....	.....	.....	1.4	1.3	1.2
22	1.4	1.2	.....	1.65	2.35	3.15	.....	.....	.....	1.4	1.3	1.2
23	1.45	1.25	.....	1.85	2.4	3.05	.....	.....	.....	1.4	1.45	1.15
24	1.45	1.3	.....	1.95	2.45	3.1	.....	.....	.....	1.4	1.3	1.1
25	1.45	1.4	.....	1.9	2.4	3.05	.....	.....	.....	1.4	1.3	1.1
26	1.5	1.4	1.1	1.75	2.45	2.65	.....	.....	.....	1.4	1.3	1.1
27	1.5	1.35	1.1	1.75	2.4	2.45	.....	.....	.....	1.45	1.4	1.1
28	1.5	1.35	1.1	1.65	2.3	2.65	.....	.....	.....	1.4	1.3	1.1
29	1.25	.....	1.1	1.5	2.15	2.75	.....	.....	.....	1.3	1.3	1.1
30	1.2	.....	1.1	1.75	2.15	2.75	.....	.....	.....	1.3	1.4	1.1
31	1.1	.....	1.1	.....	2.1	.....	.....	.....	.....	1.3	.....	.....
1907.[c]												
1	.....	.....	1.30	1.20	1.40	2.45	3.34	2.48	1.65	1.52	.....	1.50
2	.....	.....	1.30	1.30	1.36	2.48	3.58	2.50	1.65	1.55	.....	1.40
3	.....	.....	1.20	1.30	1.38	2.52	3.64	2.48	1.68	1.58	1.20	1.40
4	.....	.....	1.20	1.30	1.40	2.60	3.90	2.42	1.68	1.55	1.20	1.35
5	.....	.....	1.20	1.30	1.40	2.80	3.68	2.45	1.65	1.55	1.30	1.30
6	.....	.....	1.20	1.30	1.45	3.00	3.70	2.48	1.68	1.45	1.30	1.30
7	.....	.....	1.20	1.20	1.45	3.10	3.40	2.32	1.68	1.42	1.20	1.30
8	.....	.....	1.20	1.30	1.50	3.15	3.25	2.30	1.65	1.42	1.20	1.30
9	.....	.....	1.20	1.30	1.50	3.00	3.24	2.25	1.65	1.40	1.20	1.30
10	.....	.....	1.10	1.30	1.55	3.20	3.21	2.28	1.65	1.40	1.20	1.30

[a] Probable ice conditions January, February, and December, 1905. Ice jams December 22 and 25, 1905.
[b] Probable ice conditions January, February, and to about March 25, and December, 1906. Ice jam February 7–10, 1906.
[c] Probable ice conditions January, February, and December, 1907.

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
11			1.10	1.30	1.55	3.10	3.26	2.18	1.62	1.42	1.20	1.30
12		1.10	1.10	1.30	1.55	3.10	3.19	2.15	1.65	1.42	1.20	1.30
13		1.10	1.20	1.30	1.90	3.15	3.21	2.12	1.62	1.40	1.20	1.30
14		1.10	1.20	1.30	1.80	3.00	3.50	2.15	1.60	1.40	1.20	1.30
15		1.10	1.30	1.30	1.90	3.18	3.11	2.10	1.58	1.42	1.20	1.30
16		1.20	1.20	1.30	2.00	3.00	2.92	2.00	1.55	1.42	1.20	1.30
17		1.20	1.20	1.30	2.20	2.45	2.78	1.80	1.52	1.40	1.20	1.30
18		1.10	1.30	1.30	2.50	2.62	2.72	1.80	1.50	1.42	1.20	1.30
19		1.10	1.30	1.30	2.50	3.12	2.70	1.72	1.48	1.40	1.20	1.20
20		1.10	1.30	1.40	2.45	3.40	2.80	1.68	1.45	1.40	1.20	1.20
21		1.10	1.30	1.50	2.50	3.52	2.78	1.52	1.50	1.38	1.20	1.20
22		1.10	1.20	1.40	2.45	3.55	2.99	1.38	1.45	1.35	1.20	1.20
23		1.10	1.20	1.40	2.40	3.00	2.89	1.22	1.40	1.35	1.20	1.15
24		1.10	1.20	1.40	2.40	2.89	2.78	1.18	1.45	1.32	1.20	1.10
25		1.10	1.20	1.40	2.32	2.68	2.71	1.52	1.40	1.30	1.20	1.10
26		1.10	1.20	1.40	2.20	2.61	2.52	1.62	1.48	1.32	1.20	1.10
27		1.10	1.20	1.40	2.00	2.84	2.48	1.68	1.48	1.35	1.18	1.10
28		1.10	1.20	1.40	1.98	3.01	2.48	1.68	1.42	1.35	1.18	1.10
29			1.20	1.40	2.00	3.35	2.50	1.68	1.45	1.35	1.18	1.10
30			1.20	1.50	2.00	3.40	2.45	1.68	1.55	1.32	1.18	1.10
31			1.20		2.30		2.48	1.68		1.35		
1908.[b]												
1				1.08	1.52	2.70	3.00	2.38	1.30	1.20	1.20	1.30
2				1.20	1.50	2.52	2.80	2.22	1.30	1.10	1.30	1.30
3				1.08	1.50	2.50	2.60	2.10	1.20	1.20	1.10	1.20
4				1.15	1.52	2.52	2.60	2.10	1.30	1.00	1.20	1.20
5				1.15	1.58	2.58	2.60	2.00	1.40	1.10	1.30	1.30
6				1.15	1.60	2.55	2.40	2.10	1.50	1.20	1.10	1.20
7			1.20	1.08	1.68	2.50	2.50	1.98	1.40	1.30	1.30	1.30
8			1.25	1.08	1.65	2.52	2.60	1.92	1.40	1.38	1.20	1.20
9			1.20	1.20	1.70	2.62	2.80	1.80	1.50	1.30	1.20	1.30
10			1.20	1.08	1.72	2.80	3.00	1.72	1.30	1.20	1.30	1.20
11			1.22	1.35	1.75	2.90	3.60	1.80	1.20	1.10	1.30	1.20
12			1.25	1.40	1.75	3.60	3.80	1.70	1.10	1.20	1.20	1.30
13			1.20	1.50	1.78	3.62	3.70	1.60	1.20	1.20	1.10	1.30
14			1.20	1.52	1.78	3.82	3.50	1.52	1.10	1.10	1.20	1.20
15			1.25	1.55	1.78	3.80	3.40	1.50	1.10	1.20	1.30	1.30
16			1.20	1.55	1.80	3.78	3.20	1.40	1.20	1.10	1.20	1.30
17			1.25	1.58	1.80	3.50	3.10	1.30	1.10	1.10	1.30	1.20
18			1.22	1.62	1.80	3.20	3.10	1.40	1.20	1.00	1.20	1.30
19			1.25	1.70	1.80	2.80	2.90	1.30	1.30	1.10	1.20	1.20
20			1.20	1.72	1.85	2.90	2.80	1.20	1.40	1.20	1.30	
21			1.22	1.72	2.00	2.60	2.70	1.10	1.50	1.10	1.30	
22			1.20	1.80	2.10	2.48	2.40	1.20	1.40	1.20	1.20	
23			1.20	1.50	2.22	2.40	2.50	1.10	1.40	1.10	1.30	
24			1.08	1.50	1.80	2.52	2.40	1.20	1.30	1.20	1.30	
25			1.20	1.40	1.75	3.10	2.40	1.32	1.20	1.10	1.20	
26			1.08	1.40	1.90	3.30	2.50	1.30	1.30	1.20	1.20	
27			1.22	1.42	1.85	2.90	2.40	1.40	1.30	1.10	1.30	
28			1.20	1.48	2.20	3.00	2.30	1.50	1.40	1.20	1.30	
29			1.20	1.50	2.22	3.02	2.33	1.40	1.30	1.30	1.20	
30			1.20	1.50	2.10	3.30	2.40	1.30	1.20	1.10	1.20	
31			1.20		2.82		2.30	1.20		1.20		

[a] Probable ice conditions January, February, and December, 1907.
[b] Probable ice conditions January 1–March 7, and after December 18, 1908.

Rating table for West Fork of Boulder River near Bruffeys, Mont., for May 17, 1904, to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	20	1.80	171	2.60	590	3.40	1,190
1.10	27	1.90	208	2.70	660	3.50	1,270
1.20	37	2.00	250	2.80	730	3.60	1,350
1.30	50	2.10	295	2.90	805	3.70	1,430
1.40	66	2.20	345	3.00	880	3.80	1,510
1.50	86	2.30	400	3.10	955	3.90	1,590
1.60	110	2.40	460	3.20	1,030		
1.70	138	2.50	525	3.30	1,110		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on nine discharge measurements made during 1904, 1907, and 1908, and is well defined between gage heights 1.10 feet and 3.5 feet.

Monthly discharge of West Fork of Boulder River near Bruffeys, Mont., for 1904 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1904.					
May 17–31	1,030	250	684	20,400	A.
June	1,610	538	1,030	61,300	A.
July	1,350	286	748	46,000	A.
August	412	98	208	12,800	A.
September	138	66	105	6,250	A.
October	86	66	68.9	4,240	B.
November	66	37	42.5	2,530	C.
The period				154,000	
1905.					
March	37	27	28.5	1,750	D.
June, 29 days	1,590	460	893	35,400	A.
July	842	229	531	32,600	A.
August	208	20	84.7	5,210	A.
September	86	37	53.6	3,190	B.
October	76	37	55.9	3,440	B.
November	50	37	37.7	2,240	C.
The period				83,800	
1906.					
March	58	20	30.3	1,860	D.
April	229	27	82.5	4,910	B.
May	558	124	360	22,100	A.
June	1,310	295	853	50,800	A.
July 1–13	918	558	678	17,500	A.
October 14–31	76	50	62.1	2,220	B.
November	76	50	53.3	3,170	C.
1907.					
March	50	27	39.0	2,400	D.
April	86	37	56.3	3,350	C.
May	525	60	250	15,400	A.
June	1,310	492	868	51,600	A.
July	1,590	492	918	56,400	A.
August	525	35	263	16,200	A.
September	132	66	102	6,070	A.
October	105	50	69.0	4,240	A.
November	50	35	38.3	2,280	C.
The period				158,000	
1908.					
March 7–31	44	26	38.0	1,880	C.
April	171	26	74.8	4,450	A.
May	745	86	198	12,200	A.
June	1,530	460	851	50,600	A.
July	1,510	400	743	45,700	A.
August	448	27	133	8,180	A.
September	86	27	51.2	3,050	B.
October	63	20	34.1	2,100	B.
November	50	27	41.6	2,480	C.
December 1–19	50	37	43.8	1,650	C.
The period				132,000	

NOTE.—Discharge estimated March 11–25, 1906; November 1–2, 1907.

WEST FORK OF BOULDER RIVER AT M'LEOD, MONT.

This station was established May 4, 1907, at Koozer's private bridge, several hundred yards upstream from the highway bridge at McLeod post-office, to determine the value of the stream for irrigation and power.

The West Fork has no important tributaries, deriving the greater part of its water from melting snow. It joins the main Boulder about 1 mile below the gaging station. The drainage area above the station is 137 square miles.

Water to irrigate about 800 acres of land is diverted above this station. A Carey Land Act project reclaiming 12,000 to 15,000 acres is now under investigation, the water to be diverted from the West Fork about 12 miles above the station.

The gage datum has remained unchanged. The bed of the stream is composed of bowlders, and is rough, but permanent. Ice forms during the winter months, but results obtained are good during the open season.

Discharge measurements of West Fork of Boulder River at McLeod, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 3	Robert Follansbee	42	55	[a] 0.55	82
May 29	do	57	106	1.38	277
June 11	do	57	138	2.02	623
July 3	Follansbee and Stewart	57	219	3.12	1,480
August 13	J. E. Stewart	54	89	1.20	228
September 27 [b]	do	43	60	.70	92
1908.					
May 11	Raymond Richards	60	108	1.25	276
June 9	do	54.5	145	2.15	637
July 25	do	55.5	124	1.69	457
October 9 [b]	J. E. Stewart	47	61.7	.62	72.1

[a] Gage height uncertain. [b] Made by wading.

Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908.

[H. J. Koozer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1						1.85	2.58	1.78	0.88	0.72	0.48	0.40
2						2.30	2.85	1.72	.88	.72	.48	.40
3						1.90	3.00	1.68	.85	.72	.45	.40
4					0.55	1.75	3.35	1.65	.85	.70	.45	.40
5					.55	2.12	2.78	1.60	.88	.68	.45	.40
6					.58	2.45	2.65	1.58	.90	.68	.45	.40
7					.60	2.35	2.62	1.55	1.05	.62	.45	.40
8					.62	2.40	2.65	1.48	.95	.62	.45	.40
9					.72	2.62	2.58	1.52	.85	.58	.45	.45
10					.90	2.12	2.58	1.45	.85	.58	.45	.48
11					1.22	2.05	2.60	1.42	.85	.58	.45	.48
12					1.35	2.52	2.48	1.38	.82	.55	.45	.42
13					1.10	2.32	2.48	1.25	.78	.52	.45	.40
14					1.08	2.15	2.42	1.22	.72	.52	.45	.40
15					1.02	2.08	2.52	1.18	.70	.52	.45	.40

Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16					1.25	1.90	2.45	1.15	0.70	0.52	0.45	0.40
17					1.45	1.75	2.10	1.15	.68	.52	.45	
18					1.70	2.00	2.22	1.20	.68	.52	.45	
19					1.68	2.42	2.18	1.12	.68	.52	.45	.80
20					2.15	2.62	2.15	1.08	.68	.52	.42	
21					1.88	2.68	2.32	1.08	.62	.52	.40	
22					1.70	2.55	2.28	1.00	.62	.52	.40	
23					1.68	2.70	2.28	.90	.58	.50	.40	
24					1.48	2.20	2.20	.92	.58	.50	.40	.30
25					1.40	2.00	2.38	.92	.58	.50	.40	
26					1.28	1.95	2.10	.98	.65	.50	.40	
27					1.30	2.30	1.95	.98	.70	.48	.40	.40
28					1.28	2.70	1.85	.92	.72	.48	.40	
29					1.32	2.75	1.78	.90	.70	.50	.40	
30					1.42	2.78	1.95	.88	.72	.50	.40	
31					1.42		1.82	.88		.50		
1908.												
1				0.35	.80	2.15	2.50	1.35	.62	.52		
2				.35	.85	2.75	2.95	1.32	.62	.55		
3	1.90			.38	.98	2.60	2.88	1.28	.62	.55		
4				.30	.92	2.45	3.25	1.25	.60	.60		
5				.30	.92	2.20	2.90	1.20	.60	.60		
6			0.80	.28	1.28	2.00	2.45	1.15	.60	.60		
7		2.00		.30	1.45	2.02	2.35	1.10	.60	.60		
8				.30	1.75	2.12	2.45	1.08	.58	.60		
9				.30	1.55	2.26	2.60	1.12	.58	.60		
10	1.30			.38	1.45	2.22	2.70	1.10	.58	.60		
11				.38	1.30	2.32	2.65	1.08	.58	.65		
12				.45	1.25	2.90	2.70	1.08	.58	.65		
13			.45	.58	1.15	2.85	2.60	1.08	.58	.68		
14		.90		.68	1.08	2.75	2.50	1.08	.58	.72		
15				.70	1.10	3.05	2.40	1.02	.58	.75		
16				.72	1.12	2.90	2.35	1.02	.58	.75		
17	1.70			.80	1.12	2.55	2.25	1.05	.55	.70		
18				1.00	1.02	2.50	1.95	1.25	.55	.70		
19				1.20	1.00	2.40	1.88	.95	.55	.68		
20			.52	1.22	1.05	2.32	1.80	.90	.52	.65		
21		1.40	.42	1.30	1.08	2.18	1.88	.85	.52	.62		
22			.40	1.30	1.18	1.85	1.80	.82	.52	.60		
23	.80		.45	1.25	1.20	1.80	1.75	.82	.52	.60		
24			.40	1.12	1.22	1.85	1.70	.80	.50	.60		
25			.38	1.05	1.30	1.92	1.65	.78	.50	.60		
26			.38	.92	1.50	2.25	1.65	.78	.50	.62		
27			.40	.80	1.60	2.95	1.75	.72	.50	.60		
28		.50	.35	.80	1.72	2.30	1.65	.72	.50	.60		
29			.35	.75	1.78	2.20	1.55	.72	.50	.60		
30			.30	.75	1.85	2.38	1.52	.68	.50	.60		
31	2.20		.30		2.08		1.48	.68		.60		

NOTE.—Ice conditions during the last half of December, 1907, and January to March 19, 1908.

Rating tables for West Fork of Boulder River at McLeod, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	61	1.20	218	2.00	615	2.80	1,210
.50	68	1.30	254	2.10	680	2.90	1,295
.60	78	1.40	294	2.20	750	3.00	1,380
.70	92	1.50	338	2.30	820	3.10	1,465
.80	110	1.60	385	2.40	895	3.20	1,550
.90	132	1.70	435	2.50	970	3.30	1,640
1.00	158	1.80	490	2.60	1,050	3.40	1,730
1.10	186	1.90	550	2.70	1,130		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907 and is fairly well defined.

Rating tables for West Fork of Boulder River at McLeod, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	27	1.00	165	1.80	489	2.60	1,020
.30	34	1.10	195	1.90	543	2.70	1,102
.40	44	1.20	228	2.00	602	2.80	1,188
.50	57	1.30	264	2.10	664	2.90	1,278
.60	73	1.40	303	2.20	729	3.00	1,373
.70	92	1.50	345	2.30	797	3.10	1,473
.80	114	1.60	390	2.40	868	3.20	1,573
.90	138	1.70	438	2.50	942	3.30	1,673

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907–1909, and is fairly well defined between gage heights 0.3 foot and 2.2 feet. Above gage height 2.2 feet it is based on one measurement at gage height 3.12 feet and is only approximate.

Monthly discharge of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 4–31	715	73	264	14,700	A.
June	1,190	462	815	48,500	B.
July	1,680	479	902	55,500	B.
August	479	128	249	15,300	A.
September	172	76	105	6,250	A.
October	96	67	75.2	4,620	A.
November	67	61	63.1	3,750	B.
December	67		54.4	3,340	C.
The period				152,000	
1908.					
March 20–31	60	34	43.2	1,030	B.
April	264	33	109	6,490	A.
May	652	114	271	16,700	A.
June	1,420	489	863	51,400	B.
July	1,620	337	776	47,700	A.
August	284	88	170	10,500	A.
September	77	57	66.2	3,940	A.
October	103	60	78.1	4,800	A.
The period				143,000	

NOTE.—Discharge for December 17–31, 1907, estimated.

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

Sweetgrass Creek rises in the Crazy Mountains and flows southeastward to the Yellowstone, which it joins a short distance below Big Timber. It has no important tributaries. The drainage area is about 47 square miles.

The gaging station, which was established May 5, 1907, to determine the amount of water available for irrigation, storage, and power, is located at C. M. Rein's ranch, 16 miles northwest of Melville and 35 miles from Big Timber, on the reservoir site of a project proposed under the Carey Land Act.

A few small ditches divert water above the station. The stream freezes over during the winter months.

When the station was established a secondary gage, to be used during extreme high water, was installed at a different datum about 300 feet below the regular gage. During the high water of June and July, 1908, the regular gage was undermined, and after August 19 readings were discontinued. Beginning October 1, 1908, all gage heights refer to the secondary gage, which will be used hereafter as the regular gage. The new gage heights are not comparable with the old.

The stream bed is composed of rough gravel and is permanent.

Discharge measurements of Sweetgrass Creek above Melville, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5[a]	Robert Follansbee	41	29.9	1.42	31.9
May 30[a]	do	53	64	2.10	165
June 12	do	49	134	3.07	480
July 1	Follansbee and Stewart	49	130	2.99	462
September 26[a]	J. E. Stewart	28	22.3	1.71	48.3
1908.					
May 12[a]	Raymond Richards	45.5	57	[b] 2.22	128
May 25[a]	J. E. Stewart	61	82.7	2.11	101
June 11	Raymond Richards	50	147	[c] 3.66	614
July 23[a]	do	51	64.9	2.60	175
October 7[a]	J. E. Stewart	34	46.1	[d] 1.67	33.9

[a] Made by wading.
[b] Lower gage read 2.06 feet.
[c] Lower gage read 3.17 feet.
[d] Lower gage.

Daily gage height, in feet, of Sweetgrass Creek above Melville, Mont., for 1907 and 1908.

[Mrs. C. M. Rein, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
1			2.92	3.10	2.45	1.85	1.65	1.55	1.55
2				3.40	2.40	1.85	1.65	1.55	
3			2.80	3.70	2.50	1.85	1.65	1.55	1.55
4			2.50	3.95	2.42	1.85	1.65	1.55	1.55
5		1.45	2.70	3.70	2.38	1.85	1.65	1.55	
6		1.45	3.00	3.20	2.35	1.85	1.65	1.55	
7		1.45	3.20	3.00	2.30	1.85	1.65	1.55	1.55
8		1.45	3.12	3.32	2.20	1.85	1.65	1.55	
9		1.45	2.95	3.28	2.30	1.85	1.65	1.55	
10		1.45	2.60	3.10	2.75	1.80	1.65	1.55	
11		1.50	2.58	3.05	2.50	1.80	1.6	1.55	1.55
12		1.50	3.12	3.05	2.40	1.80	1.6	1.55	
13		1.50	3.02	3.52	2.38	1.80	1.6	1.55	1.55
14		1.50	2.72	3.10	2.35	1.80	1.6	1.55	
15		1.50	2.68	2.98	2.30	1.80	1.6	1.55	
16		1.50	2.55	3.00	2.28	1.80	1.6		
17		1.50	2.42	3.00	2.25	1.80	1.6	1.55	1.55
18		1.55	2.65	3.10	2.12	1.80	1.6		
19		2.20	3.00	2.95	2.10	1.75	1.6	1.55	
20		2.95	3.25	2.92	2.02	1.75	1.6	1.55	
21		2.80	3.30	3.20	2.00	1.75	1.6		
22		2.55	3.50	3.00	1.98	1.70	1.6	1.55	
23		2.65	3.72	2.90	1.95	1.70	1.6	1.55	
24		2.50	3.00	2.72	1.95	1.70	1.6	1.55	
25		2.25	2.85	2.62	1.95	1.70	1.6		
26		2.12	2.75	2.62	1.95	1.70	1.6	1.55	
27		2.05	3.15	2.50	1.95	1.70	1.55		
28		2.02	3.60		1.95	1.70	1.55	1.55	
29		2.00	3.80		1.92	1.70	1.55	1.55	
30		2.10	3.70		1.90	1.70	1.55	1.55	
31		2.30			1.90		1.55		

Daily gage height, in feet, of Sweetgrass Creek above Melville, Mont., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.									
1	1.40	1.40	5.15	3.30	2.30	.....	1.65	1.78	.....
2	.....	1.40	3.52	3.28	2.30	.....	1.65	1.76	.....
3	1.40	1.40	4.38	3.85	2.30	.....	1.65	1.76	.....
4	1.40	1.45	3.70	4.08	2.25	.....	1.65	1.78	.....
5	.....	1.58	3.20	3.42	2.25	.....	1.66	1.78	.....
6	1.40	1.65	3.20	3.00	2.25	.....	1.69	1.78	.....
7	1.40	1.75	3.20	3.00	2.25	.....	1.68	1.76	.....
8	1.40	2.20	3.30	3.65	2.25	.....	1.68	1.75	.....
9	.....	2.50	.....	3.68	2.20	.....	1.70	1.76	.....
10	1.40	2.40	3.62	3.65	2.20	.....	1.70	1.75	.....
11	1.40	2.30	4.02	3.35	2.15	.....	1.69	1.75	.....
12	1.40	.....	4.50	3.17	2.15	.....	1.67	.....	.....
13	.....	2.20	3.70	3.15	2.15	.....	1.65	.....	.....
14	.....	2.15	3.60	3.25	2.10	.....	1.65	.....	.....
15	1.40	2.15	4.05	3.05	2.10	.....	1.60	1.70	.....
16	1.40	2.15	3.85	2.90	2.10	.....	1.60	1.70	.....
17	.....	2.15	3.50	2.75	2.10	.....	1.62	1.70	.....
18	1.40	2.15	3.10	2.65	2.10	.....	1.62	1.72	.....
19	1.40	2.15	3.00	2.58	2.05	.....	1.62	1.75	.....
20	1.40	2.10	2.75	2.58	.....	.....	1.65	1.76	.....
21	1.40	2.10	2.65	2.58	.....	.....	1.65	.....	.....
22	1.40	2.10	2.55	2.55	.....	.....	1.65	.....	.....
23	1.40	2.05	2.52	2.55	.....	.....	1.65	1.75	.....
24	1.40	2.05	2.60	2.55	.....	.....	1.65	.....	.....
25	1.40	2.12	3.50	2.50	.....	.....	1.67	1.72	.....
26	1.40	2.20	3.80	2.50	.....	.....	1.72	.....	.....
27	1.40	2.35	3.50	2.50	.....	.....	1.70	1.70	.....
28	1.40	2.42	2.90	2.50	.....	.....	1.70	1.70	.....
29	1.40	2.42	2.68	2.45	.....	.....	1.72	.....	.....
30	1.40	2.65	2.90	2.45	.....	.....	.....	1.70	.....
31	.....	3.76	.....	2.40	.....	.....	1.75	.....	.....

NOTE.—The observer states there was a gradual fall from gage height 2.2 feet to gage height 1.65 feet during the period August 20 to September 30, 1908. Beginning October 1, 1908, gage heights refer to lower gage. Probable ice conditions December, 1907–March, 1908, November 12–14 and December, 1908.

Rating tables for Sweetgrass Creek above Melville, Mont.

MAY 5 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	30	2.10	163	2.80	382	3.50	665
1.50	43	2.20	190	2.90	419	3.60	710
1.60	58	2.30	219	3.00	457	3.70	760
1.70	75	2.40	249	3.10	495	3.80	810
1.80	94	2.50	280	3.20	535	3.90	860
1.90	115	2.60	313	3.30	575	4.00	910
2.00	138	2.70	347	3.40	620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is fairly well defined.

Rating tables for Sweetgrass Creek above Melville, Mont.—Continued.

AUGUST 1 TO DECEMBER 17, 1907.

[Daily discharge obtained by the indirect method for shifting channels.]

APRIL 1 TO JUNE 11, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	16	2.40	161	3.40	489	4.40	1,020
1.50	24	2.50	185	3.50	535	4.50	1,080
1.60	33	2.60	211	3.60	585	4.60	1,140
1.70	44	2.70	239	3.70	635	4.70	1,200
1.80	56	2.80	268	3.80	685	4.80	1,260
1.90	70	2.90	299	3.90	740	4.90	1,325
2.00	85	3.00	332	4.00	795	5.00	1,390
2.10	101	3.10	368	4.10	850	5.20	1,520
2.20	119	3.20	406	4.20	905		
2.30	139	3.30	446	4.30	960		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and one in the latter part of 1907, and is fairly well defined.

JUNE 12 TO AUGUST 31, 1908.

[Daily discharge obtained by the indirect method for shifting channels.]

OCTOBER 1 TO NOVEMBER 30, 1908.[c]

1.60	22	1.70	40	1.80	60		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and is not well defined. This table refers to the lower gage.

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for 1907 and 1908.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1	240	71	39	28	28	16	178	62	33	28	28
2	220	71	39	28	28	17	170	62	33	28	28
3	260	71	39	28	28	18	134	62	33	28	.....
4	225	71	39	28	28	19	128	53	33	28	.....
5	210	71	39	28	28	20	108	53	33	28	.....
6	203	71	39	28	28	21	103	53	33	28	.....
7	186	71	39	28	28	22	97	46	33	28	.....
8	128	71	39	28	28	23	92	46	33	28	.....
9	186	71	39	28	28	24	92	46	33	28	.....
10	350	62	39	28	28	25	92	46	33	28	.....
11	260	62	33	28	28	26	92	46	33	28	.....
12	220	62	33	28	28	27	92	46	28	28	.....
13	210	62	33	28	28	28	92	46	28	28	.....
14	203	62	33	28	28	29	86	46	28	28	.....
15	186	62	33	28	28	30	81	46	28	28	.....
						31	81	.....	28	.....	.....

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1908.				1908.				1908.			
1	.....	440	112	11	.....	452	84	21	225	172	66
2	.....	430	112	12	1,080	368	84	22	200	165	65
3	.....	675	112	13	635	355	84	23	180	165	64
4	.....	780	102	14	585	385	75	24	198	165	63
5	.....	485	102	15	822	304	75	25	525	153	62
6	.....	312	102	16	712	255	75	26	660	153	61
7	.....	312	102	17	535	212	75	27	525	153	60
8	.....	585	102	18	368	187	75	28	285	153	59
9	.....	590	93	19	332	172	67	29	218	142	58
10	.....	585	93	20	254	172	67	30	285	142	57
								31	.....	132	56

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Sweetgrass Creek above Melville, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 5–31	438	36	136	7,280	A.
June	810	255	466	27,700	A.
July	885	266	477	29,300	A.
August	350	81	158	9,720	B.
September	71	46	59.0	3,510	B.
October	39	28	34.1	2,100	C.
November	28	28	28.0	1,670	C.
December 1–17	28	28	28.0	944	C.
The period				82,200	
1908.					
April	16	16	16.0	952	D.
May	665	16	122	7,500	A.
June	1,490	180	529	31,500	B.
July	780	132	315	19,400	B.
August	112	56	79.5	4,890	B.
September			44.0	2,620	C.
October	50	22	33.9	2,080	B.
November	56	40	47.4	2,820	C.
The period				71,800	

NOTE.—Daily discharge for period August 20 to September 30, 1908, interpolated; otherwise discharge estimated for days when gage was not read.

SWEETGRASS CREEK BELOW MELVILLE, MONT.

This station, which was established May 4, 1907, to determine the amount of water available for irrigation, is located at Adams ranch, 9 miles below Melville, 20 miles from Big Timber, and 2½ miles below the head-gate of the Glass-Lindsay Land Company's canal, a Carey Land Act project.

Many diversions are made on this stream, with a total appropriation of 550 second-feet of adjudicated rights. The Glass-Lindsay canal, partly completed, will carry 575 second-feet and irrigate 30,000 acres. This canal will divert water into two storage reservoirs, with capacities of 12,000 and 6,000 acre-feet, respectively, which will be filled from the spring run-off, the low-water flow being all appropriated.

The stream bed is composed of clean gravel and is nonshifting. Ice forms during the winter season. Records obtained are good.

Discharge measurements of Sweetgrass Creek below Melville, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Robert Follansbee	41	34.6	0.84	59
May 29	do	50	59	1.30	172
June 11	do	60	82	1.51	283
June 30	Follansbee and Stewart	40	139	2.12	619
September 25	J. E. Stewart	30	44.8	.90	43
1908.					
May 12[a]	Raymond Richards	48	53	1.27	115
May 24[a]	J. E. Stewart	35	57.9	1.12	82.6
June 10	Raymond Richards	44.5	155	2.47	625
July 23[a]	do	52	54	1.30	121
October 6[a]	J. E. Stewart	34	51.2	.99	60.9

[a] Made by wading.

NOTE.—The 1907 measurements were made at various sections.

Daily gage height, in feet, of Sweetgrass Creek below Melville, Mont., for 1907 and 1908.

[E. P. Adams and A. E. Cummings, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								
1			1.55	1.90	1.58	1.02	0.92	0.85
2			1.75	1.95	1.55	1.00	1.05	.85
3			1.70	2.00	1.52	1.00	1.05	.85
4		0.85	1.58	2.10	1.52	1.00	1.00	.85
5		.85	1.55	2.05	1.50	1.00	.90	.85
6		.85	1.72	1.85	1.45	1.00	.90	.85
7		.85	1.82	1.75	1.45	1.00	.98	.85
8		.85	1.82	1.85	1.40	1.00	1.00	.85
9		.85	1.72	1.88	1.35	1.00	1.00	.85
10		.82	1.58	1.82	1.55	1.00	.98	.85
11		.88	1.52	1.75	1.60	1.00	.95	.85
12		.95	1.78	1.78	1.52	1.08	.95	.85
13		.95	1.78	1.98	1.48	1.12	.95	.85
14		.88	1.62	1.85	1.40	1.10	.95	.85
15		.85	1.65	1.95	1.40	1.05	.95	.85
16		.80	1.52	1.85	1.35	1.00	.95	.85
17		.80	1.48	1.88	1.35	1.05	.95	.85
18		1.00	1.45	1.85	1.20	1.00	.95	.85
19		1.08	1.62	1.85	1.12	1.00	.90	.85
20		1.62	1.85	1.78	1.08	1.00	.90	.85
21		1.60	1.80	1.85	1.05	1.00	.90	.85
22		1.52	1.85	1.82	1.00	.98	.85	.85
23		1.50	2.88	1.80	1.00	.90	.85	.85
24		1.50	2.05	1.72	1.00	.90	.85	.....
25		1.40	1.90	1.68	1.00	.90	.85	.....
26		1.38	1.80	1.65	1.00	.90	.85	.....
27		1.32	1.92	1.55	1.05	.90	.85	.....
28		1.30	2.08	1.55	1.02	.90	.85	.....
29		1.30	2.15	1.55	1.02	1.00	.85	.....
30		1.38	2.10	1.70	1.00	.95	.85	.....
31		1.40	.....	1.62	1.00	.....	.85	.....
1908.								
1	0.60	.60	3.60	1.98	.82	.80	.80	1.05
2	.60	.60	3.10	1.92	.72	.75	.80	1.05
3	.60	.60	3.10	2.20	.70	.72	.88	1.05
4	.60	.60	3.10	2.25	.65	.70	.90	1.10
5	.60	.60	2.60	2.18	.65	.70	.92	1.08
6	.60	.60	2.35	1.88	.60	.65	1.00	1.05
7	.60	.60	2.20	1.78	.60	.62	1.00	1.05
8	.60	.60	2.40	1.82	.60	.60	.90	.....
9	.60	.95	2.40	1.96	.52	.62	.90	.....
10	.60	1.38	2.48	2.12	.50	.68	.90	.....
11	.60	1.30	2.55	2.00	.50	.65	.90	.....
12	.60	1.28	2.95	1.90	.60	.70	.90	.....
13	.60	1.25	2.60	1.85	.62	.70	.90	.....
14	.65	1.25	2.42	1.90	.75	.70	.90	.....
15	.65	1.20	2.62	1.82	.72	.70	.90	.....
16	.60	1.20	2.60	1.75	.75	.70	1.00	.....
17	.60	1.15	2.55	1.65	.70	.70	1.00	.....
18	.60	1.15	2.20	1.48	.68	.70	.....	.....
19	.60	1.10	1.95	1.42	.65	.70	.....	.....
20	.60	1.32	1.95	1.38	.65	.70	.....	.....
21	.60	1.42	1.80	1.32	.72	.70	.....	.....
22	.60	1.28	1.72	1.30	.80	.70	.....	.....
23	.60	1.30	1.65	1.30	.75	.70	.....	.....
24	.60	1.22	1.58	1.25	.72	.70	.....	.....
25	.55	1.18	1.95	1.22	.70	.78	1.05	.....
26	.55	1.20	2.28	1.22	.70	.80	1.05	.....
27	.55	1.90	2.45	1.12	.70	.80	1.05	.....
28	.60	1.70	2.92	1.05	.72	.80	1.10	.....
29	.62	1.62	1.78	.98	.75	.80	1.05	.....
30	.60	1.68	1.65	.90	.80	.80	1.05	.....
31	.....	2.85	.....	.88	.80	.....	1.05	.....

NOTE.—Ice conditions during latter part of November and December, 1907, and November 8 to December 31, 1908.

Rating tables for Sweetgrass Creek below Melville, Mont.

MAY 4 TO JULY 31, 1907

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	52	1.40	219	2.00	545	2.60	932
.90	68	1.50	265	2.10	607	2.70	999
1.00	88	1.60	315	2.20	670	2.80	1,067
1.10	113	1.70	368	2.30	734	2.90	1,135
1.20	143	1.80	424	2.40	799		
1.30	179	1.90	483	2.50	865		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on four discharge measurements made during this period, and is fairly well defined between gage heights 0.8 foot and 2.2 feet.

AUGUST 1 TO NOVEMBER 23, 1907.

[Daily discharge obtained by the indirect method for shifting channels.]

APRIL 1 TO NOVEMBER 7, 1908.

0.50	11	1.30	121	2.10	431	2.90	885
.60	16	1.40	148	2.20	482	3.00	945
.70	23	1.50	178	2.30	535	3.10	1,005
.80	33	1.60	212	2.40	590	3.20	1,070
.90	45	1.70	250	2.50	647	3.30	1,135
1.00	60	1.80	291	2.60	705	3.40	1,200
1.10	77	1.90	335	2.70	765	3.50	1,265
1.20	97	2.00	382	2.80	825	3.60	1,330

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on five discharge measurements made during 1908 and one measurement in 1907. It is well defined between gage heights 0.8 foot and 1.4 feet. Above gage height 1.4 feet the rating curve is based on one measurement at gage height 2.5 feet.

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for 1907.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1	291	70	48	39	16	182	66	52	39
2	275	66	70	39	17	182	78	52	39
3	260	66	70	39	18	123	66	52	39
4	260	66	60	39	19	98	66	45	39
5	250	66	45	39	20	86	66	45	39
6	226	66	45	39	21	78	66	45	39
7	226	66	55	39	22	66	61	39	39
8	204	66	60	39	23	66	45	39	39
9	182	66	60	39	24	66	45	39	.....
10	275	66	55	39	25	66	45	39	.....
11	300	66	52	39	26	66	45	39	.....
12	260	86	52	39	27	78	45	39	.....
13	241	98	52	39	28	70	45	39	.....
14	204	92	52	39	29	70	66	39	.....
15	204	78	52	39	30	66	54	39	.....
					31	66	.....	39	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Sweetgrass Creek below Melville, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 4–31	326	52	140	7,780	A.
June	1,120	242	424	25,200	A.
July	607	290	434	26,700	A.
August	300	66	164	10,100	A.
September	98	45	64.8	3,860	B.
October	70	39	48.7	2,990	B.
November 1–23	39	39	39.0	1,780	C.
The period				78,400	
1908.					
April	20	14	16.1	958	C.
May	855	16	127	7,810	A.
June	1,330	205	600	35,700	A.
July	508	43	242	14,900	A.
August	35	11	22.7	1,400	C.
September	33	16	24.6	1,460	C.
October	77	33	56.0	3,440	C.
November 1–7	77	68	70.1	973	B.
The period				66,600	

NOTE.—Discharge interpolated October 18–24, 1908.

CLARK FORK AT FROMBERG, MONT.

Clark Fork enters Yellowstone River from the south about 15 miles southwest of Billings, Mont. The stream is bordered by irrigable land which is used for agriculture.

The gaging station, which was established June 3, 1905, to determine the amount of water available for irrigation, is located on the highway bridge one-half mile east of the Northern Pacific Railway station at Fromberg, Mont.

One small stream, Red Rock Creek, flows into the river between the gaging station and its mouth. The drainage area above the station is about 2,500 square miles.

As almost all the valley land is under irrigation many diversions are made, but owing to the abundance of water only a small portion of the flow is used.

The ice period ranges from December to the middle of March, but frequently during this period the river breaks up and floating ice may be seen.

The original staff gage has been replaced by a standard chain gage, but no change in gage datum has occurred. Records obtained are excellent. The gaging section would be ideal if it were not for the middle pier of the bridge which divides the channel. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent.

Discharge measurements of Clark Fork at Fromberg, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 10	J. E. Stewart	120	288	3.56	374
June 1 [a]	do	207	733	6.04	3,320
July 12	do	214	1,130	7.83	6,590
August 17	do	184	526	4.95	1,410
November 12 [b]	do	125	310	3.64	370
1908.					
March 30	J. E. Stewart	118	263	3.40	269
May 22	do	158	438	4.54	1,080
June 13	Raymond Richards	211	1,090	7.55	5,850
July 20	do	206	750	6.10	3,030
October 10	J. E. Stewart	143	375	4.18	717

[a] Measurement made without sufficient amount of lead. [b] Slight ice conditions.

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1907 and 1908.

[Mrs. E. V. Moran, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.5	5.1	3.55	3.5	4.0	6.1	7.85	6.45	4.8	4.4	3.65	3.6
2	3.5	5.1	3.5	3.58	4.4	7.0	8.95	6.35	4.8	4.5	3.65	3.6
3	3.6	5.1	3.5	3.65	4.5	6.85	8.5	6.2	4.65	4.2	3.65	3.6
4	3.8	5.1	3.5	3.65	4.55	6.25	9.0	6.2	4.6	4.0	3.65	3.55
5	3.8	5.1	3.5	3.65	3.9	6.5	9.15	6.2	4.5	4.0	3.65	3.55
6	3.8	5.1	3.45	3.65	3.8	6.95	8.55	6.05	4.5	4.0	3.6	3.55
7	3.8	5.1	3.45	3.65	3.9	7.4	8.2	5.85	4.5	4.0	3.6	3.5
8	3.8	4.25	3.45	3.5	3.9	7.6	8.05	5.8	4.55	3.9	3.6	3.5
9	3.9	4.25	3.45	3.42	3.9	7.25	8.1	5.7	4.5	3.9	3.6	3.5
10	5.1	4.25	3.4	3.55	4.15	6.95	7.95	5.6	4.5	3.9	3.6	3.5
11	5.1	4.25	3.4	3.55	4.5	6.6	7.75	5.4	4.5	3.9	3.55	3.5
12	5.1	4.25	3.4	3.6	5.1	6.55	7.85	5.4	4.5	3.9	3.5	3.5
13	5.1	4.25	3.35	3.7	4.8	6.7	7.65	5.15	4.5	3.9	3.5	3.5
14	5.1	4.25	3.35	3.7	4.7	6.45	7.45	5.0	4.4	3.9	3.5	3.5
15	5.1	3.6	3.35	3.78	4.8	6.95	7.55	4.9	4.4	3.85	3.5	3.5
16	5.1	3.6	3.35	3.9	5.55	7.15	7.45	4.9	4.3	3.85	3.5	3.5
17	5.1	3.6	3.4	4.1	5.65	6.8	6.85	4.9	4.3	3.8	3.7	3.5
18	5.1	3.6	3.4	4.1	6.0	6.65	6.45	5.0	4.2	3.8	3.7	3.5
19	5.1	3.6	3.4	3.8	6.0	6.85	6.8	4.9	4.2	3 8	3.6	3.5
20	5.1	3.6	3.4	3.75	6.25	7.1	6.9	4.85	4.2	3.8	3.6	3.5
21	5.1	3.6	3.7	3.75	6.35	7.4	7.05	4.8	4.1	3.8	3.6	3.5
22	5.1	3.65	3.7	3.7	6.6	7.55	7.25	4.8	4.1	3.75	3.6	3.5
23	5.1	3.6	3.7	3.7	6.65	7.65	7.35	4.7	4.0	3.75	3.6	3.5
24	5.1	3.6	3.6	3.7	6.3	6.9	7.15	4.65	4.0	3.75	3.6	3.5
25	5.1	3.6	3.6	3.8	6.0	6.7	7.45	4.55	3.9	3.75	3.6	3.5
26	5.1	3.6	3.6	3.8	5.75	6.6	7.5	4.6	3.9	3.7	3.6	3.5
27	5.1	3.6	3.6	3.8	5.1	6.8	7.45	4.55	4.1	3.7	3.6	3.5
28	5.1	3.52	3.6	3.8	5.15	7.2	6.85	4.5	4.1	3.7	3.6	3.5
29	5.1	.....	3.65	3.75	5.2	8.15	6.6	4.9	4.55	3.7	3.6	3.5
30	5.1	.....	3.65	3.75	5.3	7.85	6.5	4.85	4.45	3.7	3.6	3.5
31	5.1	.....	3.65	.....	5.65	.....	6.4	4.8	.....	3.7	.....	3.5
1908.												
1	3.5	.....	3.2	3.4	4.25	6.95	7.65	5.4	4.4	3.9	3.9	3.5
2	3.5	.....	3.2	3.4	4.4	6.55	7.5	5.4	4.3	3.9	3.9	3.5
3	3.5	.....	3.2	3.45	4.9	7.05	7.8	5.3	4.3	3.9	3.9	3.5
4	3.5	.....	3.2	3.48	5.0	6.4	7.85	5.3	4.2	4.05	3.9	3.5
5	3.5	.....	3.4	3.4	4.9	5.85	8.4	5.3	4.15	4.2	3.9	3.5
6	3.5	.....	3.4	3.42	5.0	5.9	7.95	5.2	4.1	4.1	3.85	3.5
7	3.5	.....	3.4	3.45	5.35	6.2	7.45	5.2	4.1	4.1	3.85	3.6
8	3.5	.....	3.4	3.5	5.9	6.55	7.1	5.2	4.0	4.1	3.85	3.6
9	3.5	.....	3.4	3.5	6.05	6.4	7.1	5.2	3.9	4.1	3.85	3.6
10	3.5	.....	3.45	3.52	6.15	6.6	7.5	5.0	3.9	4.1	3.85	3.6
11	3.5	.....	3.5	3.55	5.6	7.4	7.4	4.8	3.95	4.1	3.8	3.6
12	3.5	.....	3.5	3.55	5.05	7.85	7.25	5.4	4.05	4.1	3.8	3.6
13	3.5	.....	3.5	3.58	4.95	7.85	7.1	5.5	4.1	4.1	3.8	3.6
14	3.5	3.5	3.5	3.65	4.85	7.75	6.85	5.45	4.1	4.1	3.8	3.6
15	3.5	3.5	3.5	3.8	4.75	8.15	6.8	5.05	4.0	4.1	3.8	3.6

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16	3.5	3.5	3.5	4.5	4.7	8.05	6.7	4.8	4.0	4.1	3.8	3.5
17	3.5	3.2	3.5	4.5	4.6	7.6	6.6	4.8	4.0	4.1	3.8	.....
18	3.5	3.2	3.5	4.15	4.55	7.35	6.4	4.8	4.05	4.1	3.8	.....
19	3.5	3.2	3.5	4.5	4.6	6.5	6.4	4.8	4.05	4.1	3.7	.....
20	3.5	3.2	3.5	4.45	4.9	6.75	6.25	5.05	4.0	4.1	3.7	.....
21	3.5	3.2	3.5	5.1	5.4	7.15	5.95	4.8	4.0	4.0	3.7	.....
22	3.5	3.2	3.5	4.95	4.62	6.25	5.85	4.7	4.0	4.0	3.7	.....
23	3.5	3.2	3.5	5.05	4.8	6.4	5.85	4.7	4.0	4.0	3.65	.....
24	3.5	3.2	3.5	4.8	5.05	6.3	5.7	4.7	4.0	4.0	3.65	.....
25	3.5	3.2	3.45	5	4.75	6.3	5.7	4.6	4.0	3.9	3.6	.....
26	3.5	3.2	3.45	5.5	4.85	6.65	5.6	4.6	3.9	3.9	3.6	.....
27	3.5	3.2	3.48	4.3	5.1	6.6	5.65	4.5	3.9	3.9	3.5	.....
28	3.5	3.2	3.45	4.25	5.55	6.65	5.6	4.5	3.9	3.9	3.5	.....
29	3.5	3.2	3.45	4.1	5.65	6.75	5.6	4.3	3.9	3.9	3.5	.....
30	.....	.....	3.45	4.1	5.8	7.4	5.5	4.5	3.9	3.9	3.5	.....
31	.....	.....	3.45	.....	6.6	.....	5.45	4.4	.....	3.9	.....	.....

NOTE.—Ice conditions January 4 to February 14, 1907; January 30 to February 13, 1908, and December 17 to 31, 1908. From January 4 to February 14, 1907, there was an open channel in the center above the bridge, but the river was frozen across below; the readings were taken to top of ice and there was considerable backwater effect. During December 17 to 31, 1908, the river was frozen at the gage, but was open in the center.

Rating tables for Clark Fork at Fromberg, Mont.

JUNE 3, 1905, TO JULY 5, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	250	4.50	1,192	5.80	2,819	7.20	5,600
3.30	296	4.60	1,293	5.90	2,975	7.40	6,080
3.40	346	4.70	1,397	6.00	3,135	7.60	6,570
3.50	400	4.80	1,504	6.10	3,300	7.80	7,070
3.60	458	4.90	1,615	6.20	3,475	8.00	7,590
3.70	520	5.00	1,730	6.30	3,660	8.20	8,130
3.80	587	5.10	1,849	6.40	3,850	8.40	8,680
3.90	660	5.20	1,973	6.50	4,050	8.60	9,240
4.00	738	5.30	2,102	6.60	4,260	8.80	9,820
4.10	821	5.40	2,236	6.70	4,470	9.00	10,400
4.20	908	5.50	2,375	6.80	4,690	9.20	10,980
4.30	999	5.60	2,519	6.90	4,910		
4.40	1,094	5.70	2,667	7.00	5,140		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on twelve discharge measurements made during this period, and is well defined between gage heights 3.5 feet and 7.5 feet.

JULY 6, 1907, TO DECEMBER 31, 1908.

3.20	190	4.50	1,000	5.80	2,510	7.20	5,080
3.30	228	4.60	1,085	5.90	2,660	7.40	5,530
3.40	272	4.70	1,175	6.00	2,820	7.60	6,010
3.50	320	4.80	1,270	6.10	2,980	7.80	6,520
3.60	370	4.90	1,370	6.20	3,150	8.00	7,070
3.70	425	5.00	1,470	6.30	3,320	8.20	7,660
3.80	485	5.10	1,580	6.40	3,500	8.40	8,280
3.90	550	5.20	1,700	6.50	3,680	8.60	8,940
4.00	615	5.30	1,820	6.60	3,870	8.80	9,620
4.10	685	5.40	1,950	6.70	4,060	9.00	10,340
4.20	760	5.50	2,080	6.80	4,250		
4.30	835	5.60	2,220	6.90	4,450		
4.40	915	5.70	2,360	7.00	4,650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during this period and upon the form of the previous curve. It is well defined between gage heights 3.5 feet and 8.0 feet.

Monthly discharge of Clark Fork at Fromberg, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
February 15–28	489	412	457	12,700	C.
March	520	321	405	24,900	C.
April	821	357	533	31,700	B.
May	4,360	587	2,030	125,000	A.
June	8,000	3,300	5,140	306,000	A.
July	10,800	3,500	6,180	380,000	A.
August	3,590	1,000	1,850	114,000	A.
September	1,270	550	888	52,800	A.
October	1,000	425	542	33,300	A.
November	425	320	369	22,000	B.
December	370	320	327	20,100	D.
The period				1,120,000	
1908.					
February 14–29	320	190	214	6,790	C.
March	320	190	290	17,800	B.
April	2,080	272	731	43,500	A.
May	3,870	798	1,680	103,000	A.
June	7,510	2,580	4,510	268,000	B.
July	8,280	2,020	4,180	257,000	B.
August	2,080	835	1,440	88,500	A.
September	915	550	645	38,400	A.
October	760	550	634	39,000	B.
November	550	320	458	27,300	B.
December 1–16	370	320	348	11,000	C.
The period				900,000	

NOTE.—Discharges for periods December to March that have been computed on the assumption of open-channel conditions should be accepted with caution, as no definite information in regard to exact ice conditions were obtained.

PRYOR CREEK AT HUNTLEY, MONT.

Pryor Creek rises in the Pryor Mountains in southern Carbon County, Mont., flows northeastward, and enters Yellowstone River from the south about 15 miles northeast of Billings.

The channel is straight with uniform slope for 800 feet above and below the station. The banks are steep and uniformly graded, are clean, and will not overflow. The current is moderate. The bed is composed of clay and gravel and may change somewhat. On the upper portion of the stream some water is diverted for irrigation.

The gaging station was originally established August 6, 1904, to determine the amount of water available for irrigation. On June 15–16, 1906, the creek was turned into a new channel (Pl. VI, *B*) by the United States Reclamation Service, and a station was established on the steel highway bridge crossing this channel one-half mile from the railroad station at Huntley. Since then the gage datum has not been changed.

The stream freezes over during the winter months. Results obtained are good.

Discharge measurements of Pryor Creek at Huntley, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	J. E. Stewart	34	41.6	1.43	34.8
May 30	do	34	61.0	2.00	106
June 22	do	34	48.0	1.91	88.0
July 10	do	34	34.0	1.23	29.8
August 15	do	25	28.0	1.13	24.0
1908.					
March 28	J. E. Stewart	25	35.5	1.32	33.6
May 21	do	42	129	4.14	514
June 15	Raymond Richards	31.5	55.7	1.75	73.3
July 22[a]	do	26.5	12.6	1.01	10.9
October 12	J. E. Stewart	28.5	40.4	1.32	30.4

[a] Made by wading.

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1907 and 1908.

[Jack O'Neil, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1			1.25	1.40	2.27	1.85	1.25	1.22	1.15	1.28	1.10	1.30
2			1.25	1.35	2.30	1.80	1.22	1.20	1.15	1.40	1.10	1.30
3			1.50	1.20	1.80	1.81	1.20	1.20	1.15	2.35	1.10	1.30
4			1.30	1.15	1.55	1.90	1.20	1.20	1.10	2.05	1.10	1.30
5			1.05	1.10	1.55	1.79	1.20	1.20	1.10	1.30	1.10	1.30
6			1.35	1.30	1.55	1.78	1.20	1.20	1.15	1.20	1.10	1.20
7			.95	1.45	1.55	1.84	1.20	1.20	1.15	1.20	1.10	1.20
8			1.35	1.40	1.53	1.76	1.20	1.10	1.18	1.20	1.10	1.40
9			1.35	1.40	1.50	1.72	1.25	1.10	1.18	1.20	1.10	1.40
10			1.05	1.38	1.50	1.68	1.30	1.10	1.20	1.20	1.10	1.40
11			1.10	1.35	1.50	1.62	1.30	1.10	1.15	1.20	1.10	2.00
12			1.05	1.35	1.60	1.62	1.62	1.10	1.10	1.20	1.10	2.00
13			1.05	1.36	3.15	1.62	1.58	1.10	1.18	1.20	1.10	2.00
14			1.10	1.35	2.47	1.52	1.50		1.18	1.20	1.10	2.00
15		4.35	1.05	1.35	1.93	1.54	1.78		1.15	1.15	1.40	1.50
16		4.55	1.10	1.35	1.90	1.50	2.08		1.15	1.10	1.40	1.50
17		3.80	1.10	1.36	1.70	1.50	2.22		1.15	1.10	1.40	1.50
18		3.38	1.15	1.36	1.63	1.50	2.18		1.15	1.10	1.40	1.40
19		4.30	1.15	1.35	1.73	1.50	1.80		1.10	1.10	1.50	1.30
20		4.20	1.18	1.35	1.70	1.50	1.58		1.15	1.10	1.50	1.30
21		3.35	1.12	1.35	1.70	1.58	1.50		1.15	1.10	1.45	1.20
22		2.15	1.10	1.36	1.70	1.70	1.50		1.15	1.10	1.40	1.30
23		1.80	1.12	1.36	1.75	1.78	1.48		1.15	1.10	1.35	1.30
24		1.50	1.08	1.36	1.85	1.80	1.40		1.15	1.10	1.30	1.20
25		1.45	1.08	1.41	2.63	1.62	1.40		1.15	1.10	1.30	1.20
26		1.28	1.18	1.45	4.40	1.40	1.25		1.10	1.10	1.25	1.20
27		1.35	1.22	1.52	3.23	1.38	1.20		1.15	1.10	1.00	1.20
28		1.15	1.15	1.65	2.27	1.30	1.20		1.15	1.10	1.00	1.20
29			1.45	1.81	1.97	1.30	1.20	1.20	1.25	1.10	1.20	1.40
30			1.55	1.94	1.90	1.25	1.22	1.15	1.25	1.10	1.40	1.50
31			1.28		1.90		1.25	1.20		1.10		1.50
1908.												
1	1.50	1.60	3.00	2.80	1.50	3.00	1.40	1.00	1.10	1.29	1.40	1.32
2	1.50	1.60		1.60	1.51	3.40	1.40	1.00	1.20	1.18	1.40	1.30
3	1.50	1.50		1.51	1.50	2.10	1.40	1.00	1.20	1.20	1.40	1.30
4	1.50	1.50		1.50	1.58	1.90	1.40	1.00	1.20	1.20	1.40	1.30
5	1.50	1.50	2.80	1.50	1.40	1.90	1.40	1.00	1.20	1.20	1.40	1.30
6	1.50	1.60		1.40	1.51	1.99	1.40	1.00	1.10	1.20	1.40	
7	1.60	1.60		1.48	1.49	1.60	1.40	1.00	1.10	1.20	1.40	
8	1.60	1.60	2.80	1.50	1.40	2.10	1.40	1.00	1.10	1.76	1.40	
9	1.60	1.60		1.49	1.40	2.00	1.40	1.06	1.10	2.10	1.40	
10	1.60			2.00	1.40	2.00	1.40	.90	1.10	1.90	1.39	
11	1.60			1.45	1.46	1.80	1.40	.90	1.10	1.90	1.30	
12	1.60		2.80	1.52	1.56	1.80	1.20	.90	1.10	1.30	1.30	1.70
13	1.60			1.49	1.48	1.70	1.20	1.00	1.10	1.30	1.29	
14	1.60			1.50	1.40	2.00	1.10	1.00	1.10	1.29	1.37	
15	1.50		3.00	1.59	1.46	1.70	1.10	.90	1.10	1.29	1.37	
16	1.50	2.10		1.50	1.96	1.70	1.10	.90	1.10	1.29	1.37	
17	1.50			1.59	1.90	1.70	1.10	.90	1.10	1.39	1.40	
18	1.50			1.60	1.58	1.70	1.10	.90	1.10	1.36	1.40	
19	1.50			1.62	1.48	1.70	1.10	.90	1.10	1.27	1.40	1.70
20	1.50	1.60		1.62	1.60	1.70	1.20	1.00	1.10	1.28	1.40	

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
21	1.50	.....	1.40	1.70	4.10	1.70	1.20	1.00	1.10	1.28	1.40	.....
22	1.50	.....	1.40	1.80	3.08	1.70	1.10	1.10	1.10	1.28	1.32	.....
23	1.50	2.00	1.40	2.26	4.10	1.70	1.10	1.10	1.10	1.24	1.50	.....
24	1.50	.....	1.30	2.20	4.86	1.70	1.10	1.10	1.10	1.22	1.40	.....
25	1.60	.....	1.30	2.28	3.60	1.70	1.10	1.10	1.10	1.23	1.40	.....
26	1.60	.....	1.30	1.28	1.90	1.70	.50	1.10	1.10	1.24	1.40	1.75
27	1.60	3.00	1.30	1.28	2.70	1.70	.50	1.10	1.10	1.24	.....	.....
28	1.60	.....	1.32	1.10	4.65	1.50	.50	1.10	1.10	1.23	.....	.....
29	1.60	.....	1.32	1.40	4.45	1.50	.60	1.10	1.10	1.21	1.32	.....
30	1.60	.....	1.32	1.40	3.40	1.40	.80	1.10	1.10	1.30	1.32	.....
31	1.60	.....	1.32	.....	4.70	.....	.90	.....	.....	1.29	.....	.....

NOTE.—Ice conditions January 1 to February 14, 1907, November 15, 1907 to March 21, 1908, and after November 26, 1908.

Rating table for Pryor Creek at Huntley, Mont., for 1907 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	0	1.60	56	2.60	186	3.60	371
.60	1	1.70	67	2.70	202	3.70	393
.70	3	1.80	78	2.80	218	3.80	415
.80	5	1.90	90	2.90	235	3.90	437
.90	8	2.00	102	3.00	253	4.00	460
1.00	11	2.10	115	3.10	271	4.20	507
1.10	15	2.20	128	3.20	290	4.40	555
1.20	20	2.30	142	3.30	309	4.60	605
1.30	27	2.40	156	3.40	329	4.80	655
1.40	36	2.50	171	3.50	350	5.00	705
1.50	46						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 15 discharge measurements made during 1906–1908, and is well defined below gage height 2.5 feet. Above gage height 2.5 feet the rating depends upon one measurement at gage height 4.14 feet.

Monthly discharge of Pryor Creek at Huntley, Mont., for 1907 and 1908.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 15–28	592	18	257	0.321	0.17	7,140	B.
March	51	10	21.2	.026	.03	1,300	B.
April	95	15	36.8	.046	.05	2,190	B.
May	555	46	111	.139	.16	6,820	A.
June	90	24	58.6	.073	.08	3,490	B.
July	131	20	42.4	.053	.06	2,610	B.
August	21	15	18.1	.023	.03	1,110	C.
September	24	15	18.1	.023	.03	1,080	B.
October	149	15	25.3	.032	.04	1,560	B.
November 1–14	15	15	15.0	.019	.01	416	C.
The period	.....	.....	.....	.....	.....	27,700	
1908.							
March 21–31	36	27	30.2	.038	.02	659	B.
April	218	15	62.7	.078	.09	3,730	A.
May	630	36	184	.230	.27	11,300	A.
June	329	36	89.2	.112	.12	5,310	A.
July	36	0	20.6	.026	.03	1,270	B.
August	15	8	11.5	.014	.02	707	C.
September	20	15	15.7	.020	.02	934	C.
October	115	19	33.0	.041	.05	2,030	B.
November	46	26	34.8	.044	.05	2,070	B.
The period	.....	.....	.....	.....	.....	28,000	

NOTE.—Discharge estimated August 14 to 28, 1907 and August 31, November 27 to 30, 1908.

BIGHORN RIVER DRAINAGE BASIN.

DESCRIPTION.

Bighorn River is formed by the junction of Big and Little Wind rivers near Riverton, Wyo.

Big Wind River rises some 50 miles southeast of the Yellowstone National Park in the mountains of the Shoshone and Wind River ranges, whose highest peaks attain altitudes of more than 12,000 feet, and flows in a general southeasterly direction for about 100 miles to its mouth, where the elevation is 5,100 feet. The upper part of its basin is hilly and mountainous except along the river and its tributaries, where the bottom lands average a mile or so in width. About 40 miles above Riverton the valley broadens out and includes stretches of land several miles in width excellently adapted to agriculture. The most important tributary of Big Wind River is Bull Lake Creek; among other tributaries may be mentioned Red, Dinwoodie, Dry, Willow, and Meadow creeks.

Little Wind River rises on the eastern side of the Wind River Range and flows eastward for about 50 miles to its confluence with Big Wind River. At the junction of the North and South forks of the Little Wind, near Fort Washakie, the valleys of these streams widen out into an excellent agricultural section. Above Fort Washakie the drainage area is generally hilly and mountainous in character.

The principal tributary of Little Wind River is the Popo Agie, which rises in the high mountains and flows in a northeasterly direction to its confluence with the Little Wind River at Arapahoe, Wyo., and which emerges from the mountains about 8 miles above Lander, Wyo. This stream at its mouth is considerably larger than Little Wind River. Important tributaries of the Popo Agie are the North Fork, which enters just below Lander, and the Little Popo Agie, which comes in at Hudson about 10 miles below Lander. The valleys of the Popo Agie and its tributaries are comparatively wide and form one of the oldest irrigated sections of Wyoming. Among the other tributaries of the Little Wind River are St. Lawrence, Sage, and Trout creeks.

From Riverton, Wyo., to its junction with the Yellowstone near Bighorn, Mont., a distance of about 250 miles, the Bighorn flows northward. At Thermopolis, 55 miles below Riverton, the elevation is about 4,200 feet; at the mouth of the Shoshone, 90 miles below Thermopolis, it is 3,800 feet; and at the mouth of the Bighorn it is about 2,700 feet.

Owl Creek, No Wood River, Grey Bull River, Shell Creek, Shoshone River, and Little Bighorn are important tributaries of the Bighorn. The drainage area of the Bighorn River above the mouth of the Shoshone is about 15,500 square miles.

The mountainous area drained by the Bighorn and its tributaries contain several hundred square miles of timber land, a great part of which is included in national forests. The remainder of the area, with the exception of occasional strips of land under cultivation, may be classed as range and sagebrush land.

The rainfall seems to vary from 20 inches or more above an altitude of 9,000 feet to an average of 12 to 15 inches at elevations from 4,000 to 7,000 feet. Below an altitude of 4,000 feet the rainfall is locally less than 12 inches.

The winters on the upper Bighorn above an altitude of 4,500 feet are severe. Snowfall is abundant in the high mountains, and heavy snowstorms also take place in the more open country, but in the plains section the snow does not usually remain for long periods. As compared with those in the upper basin the winters in what is called the Bighorn Basin are fairly mild. This basin begins where the river emerges from the canyon above Thermopolis and extends nearly to the mouth of the river. Most of the lower drainage area of Shoshone River is included in this basin. This belt is subject to the influence of the so-called chinook winds. Nearer the mouth of the stream the winters are more severe.

Irrigation along Bighorn River is developing very rapidly. For a number of years irrigation has been practiced in comparatively restricted tracts at various points along the stream and its tributaries, as in the Lander and Thermopolis districts in Wyoming, and in the Crow Reservation in Montana, as well as on the No Wood, Grey Bull, Shoshone, and other tributaries; but such irrigation has used only a small part of the total flow of these streams. Extensive irrigation works now being constructed by the Indian Service on the Shoshone Reservation in Wyoming and the Crow Reservation in Montana will eventually serve probably 225,000 acres; the Shoshone project of the United States Reclamation Service will provide for the irrigation of more than 125,000 acres along Shoshone River; by using some of the storage sites on Big Wind River the Wyoming Central Irrigation Company will irrigate several hundred thousand acres of land near Riverton, and other private enterprises will irrigate considerable land near Basin. Many opportunities for additional projects are to be found on the tributary streams.

As a large part of the drainage area of Bighorn River has never been carefully surveyed, the full extent of the storage possibilities is not very well known, but undoubtedly many excellent reservoir sites exist at the headwaters of Big Wind and Little Wind rivers. Among others may be mentioned the site on Bull Lake Creek, which is situated at a natural lake on this stream, and many similar lakes are to be found in that locality. It is believed that very good sites can be found for storing the flood waters of Paint Rock, Owl Creek,

Shell Creek, and Grey Bull River. Many of these streams have a large annual run-off, but some of them are intermittent in character.

Probably the best reservoir site in the area is the one which the Reclamation Service is now developing on Shoshone River 8 miles above Cody, Wyo. With a dam 310 feet high above foundation, the reservoir will have a capacity of 456,000 acre-feet. (See Pls. VIII and IX.)

The value of the land along the Bighorn River and its tributaries for agriculture will probably restrict water-power development to streams of the headwater regions. The fall of many of these streams exceeds 300 feet to the mile. Popo Agie and Little Wind rivers probably afford the best opportunities. In the canyon of the Bighorn above Thermopolis, where the Big Horn Company is now constructing a plant with a capacity of about 5,000 horsepower, at least 25,000 horsepower can be developed. Of the 100,000 horsepower or more which might easily be developed, probably less than 1,000 horsepower are now being utilized.

For gaging stations maintained in this basin see page 143.

BIG WIND RIVER NEAR RIVERTON, WYO.[a]

This station was established May 14, 1906, to determine the amount of water available for storage and irrigation, and was abandoned October 25, 1908, but records are available for only part of this period. It was located at Walker's ferry, 7 miles northeast of Arapahoe, about 2 miles above Riverton, and 2 miles above the mouth of Little Wind River.

Except for the canal systems of the United States Indian Service, which divert water from several tributaries, present diversions above this station are limited to one canal of the Wyoming Central Irrigation Company, which irrigates probably 20,000 acres. Other canals under construction or contemplation by this company will eventually divert water for the irrigation of several hundred thousand acres.

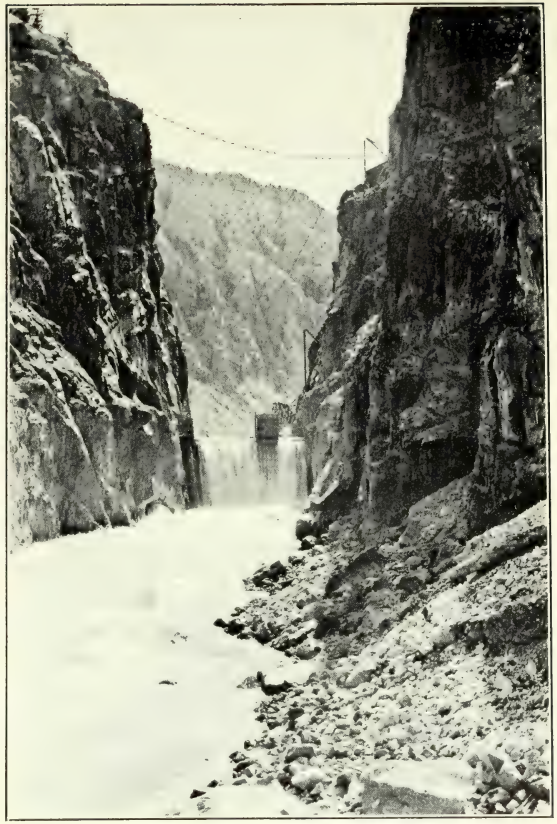
Ice prevails for several months during the winter season, but no winter records were kept.

On July 13, 1906, a new gage was installed, differing in location and datum from the original gage. This gage was replaced on August 24, 1907, by another gage, near the site of the original gage and as nearly as could be determined at the same datum, and this last datum was used until the station was abandoned.

Very good discharge measurements were obtained at this station, and the results are considered very satisfactory, though the channel shifts considerably during floods.

[a] Referred to in Water-Supply Paper 208 as "near Arapahoe Agency."

A. SHOSHONE DAM SITE, SHOSHONE RIVER, WYOMING.



B. SHOSHONE DAM, SHOSHONE RIVER, WYOMING.

Discharge measurements of Big Wind River near Riverton, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 24	W. B. Freeman	231	449	2.02	1,740
October 19	do	225	274	1.06	685
1908.					
June 16	W. B. Freeman	232	1,040	4.78	7,840
July 24	J. B. Stewart	234	620	2.90	3,600
August 27	do	173	588	1.50	1,760
November 6	W. B. Freeman	106	153	−0.21	578

Daily gage height, in feet, of Big Wind River near Riverton, Wyo., for 1907 and 1908.

[Andrew Walker, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1		2.15	1.30	1.00	0.98	16		1.08		0.85	1.00
2		1.42	1.30	.95	.95	17		1.09		.85	1.28
3		1.45	1.30	.95	.95	18		1.02		.80	1.55
4		1.38	1.28	.95	.95	19		1.09	1.05	.80	1.55
5		1.35	1.20	.95	.95	20		1.09	1.05	.72	1.55
6		1.40	1.20	.95	.95	21		1.09	1.05	.62	1.55
7		1.42	1.25	.95	.95	22		1.35	1.05	.72	1.55
8		1.40	1.22	.90	.95	23		1.22	1.05	.80	1.55
9		1.32	1.20	.90	.95	24	2.04	1.25	1.05	.85	1.55
10		1.30	1.15	.90	.98	25	2.30	1.25	1.05	.90	1.90
11		1.20	1.12	.90	1.00	26	2.15	1.25	1.05	.90	1.90
12		1.12	1.10	.85	1.00	27	2.32	1.25	1.05	1.00	2.05
13		1.12	1.10	.85	1.00	28	2.30	1.25	1.05	1.00	2.05
14		1.12	1.15	.85	1.00	29	2.20	1.32	1.05	1.00	2.05
15		1.08	1.12	.85	1.00	30	2.18	1.38	1.05	1.00	2.05
						31	2.12		1.00		2.05

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1908.							1908.						
1	1.1	2.8	3.95	2.85	0.8	0.4	16	1.65	4.75	3.7	2.3	0.6	0.35
2	1.15	2.4	3.9	2.75	.6	.5	17	1.6	4.7	3.5	2.1	.7	.4
3	1.25	2.2	4.1	2.75	.55	.6	18	1.6	4.2	3.45	1.9	.7	.3
4	1.5	2.1	4.2	2.7	.5	.6	19	1.5	3.9	3.4	1.9	.7	.3
5	1.5	2.0	4.6	2.6	.4	.7	20	1.65	3.5	3.4	1.95	.6	.25
6	1.55	1.95	4.2	2.6	.4	.7	21	1.7	3.05	3.35	1.9	.5	.2
7	1.8	2.05	4.0	2.55	.45	.6	22	1.6	2.9	3.15	2.1	.4	.15
8	2.0	2.6	3.9	2.5	.5	.5	23	1.75	2.8	3.1	2.2	.3	.15
9	2.3	2.6	4.0	2.35	.6	.6	24	1.85	2.65	3.05	2.05	.25	.1
10	2.5	2.8	4.2	2.2	.65	.55	25	1.7	3.1	3.05	1.8	.35	.15
11	2.05	3.4	4.2	2.1	.7	.5	26	1.9	3.6	2.95	1.6	.5	.....
12	1.85	3.8	3.95	2.2	.7	.45	27	2.05	4.1	2.9	1.5	.5	.....
13	1.8	4.1	3.9	2.1	.7	.4	28	1.9	4.1	3.05	1.2	.4	.....
14	1.8	4.3	3.75	2.2	.7	.4	29	1.8	3.6	3.1	1.1	.5	.....
15	1.65	4.6	3.7	2.6	.65	.4	30	1.8	3.75	3.05	.95	.5	.....
							31	2.05	.....	3.0	.9	.....	.....

NOTE.—River frozen, December 17 to 31, 1907. The channel was away from the gage after October 25, 1908.

Rating tables for Big Wind River near Riverton, Wyo.

AUGUST 24, 1907, TO JULY 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	380	1.60	1,200	2.60	2,680	3.60	4,900
.70	435	1.70	1,320	2.70	2,870	3.70	5,160
.80	500	1.80	1,440	2.80	3,070	3.80	5,430
.90	570	1.90	1,570	2.90	3,280	3.90	5,710
1.00	640	2.00	1,710	3.00	3,500	4.00	6,000
1.10	720	2.10	1,860	3.10	3,720	4.20	6,580
1.20	800	2.20	2,010	3.20	3,950	4.40	7,170
1.30	890	2.30	2,170	3.30	4,180	4.60	7,780
1.40	990	2.40	2,330	4.40	4,410	4.80	8,430
1.50	1,090	2.50	2,500	3.50	4,650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907–8 and the form of the 1906 curve, and is well defined between gage heights 1.0 foot and 5.0 feet.

JULY 6, TO OCTOBER 25, 1908.

Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	760	1.10	1,430	2.10	2,430	3.10	3,950
.20	820	1.20	1,510	2.20	2,560	3.20	4,140
.30	880	1.30	1,590	2.30	2,700	3.30	4,340
.40	945	1.40	1,670	2.40	2,840	3.40	4,550
.50	1,010	1.50	1,760	2.50	2,980	3.50	4,760
.60	1,075	1.60	1,850	2.60	3,130	3.60	4,980
.70	1,140	1.70	1,950	2.70	3,280	3.70	5,220
.80	1,210	1.80	2,060	2.80	3,440	3.80	5,470
.90	1,280	1.90	2,180	2.90	3,600	3.90	5,730
1.00	1,350	2.00	2,300	3.00	3,770	4.00	6,000

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period, and is fairly well defined. Above gage height 4.0 feet it is the same as the preceding table.

Monthly discharge of Big Wind River near Riverton, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 24–31	2,200	1,770	2,020	32,100	A.
September	1,940	656	882	52,500	A.
October	890	640	741	45,600	A.
November	640	391	559	33,300	B.
December	640	605	630	38,700	D.
The period				202,000	
1908.					
May	2,500	720	1,390	85,500	A.
June	8,260	1,640	4,370	260,000	A.
July	7,780	3,600	5,110	314,000	A.
August	3,520	1,280	2,480	152,000	A.
September	1,210	850	1,040	61,900	B.
October	1,140	680	909	55,900	C.
The period				929,000	

NOTE.—Discharge estimated October 16 to 18, December 17 to 31, 1907, and October 26 to 31, 1908. The Wyoming Central canal was carrying 30 second-feet August 24, 1907, and 10 second-feet on October 18, 1907.

BIGHORN RIVER NEAR HARDIN, MONT.[a]

This station, which was established June 16, 1904, to determine the amount of water available for irrigation, is located at the bridge of the Burlington and Missouri River Railroad about one-half mile

[a] Referred to as at "Fort Custer" in Water-Supply Paper 208, p. 96.

above the junction of Bighorn and Little Bighorn rivers, and 2 miles from Hardin. Water is diverted a few miles above the station by a private irrigation company to irrigate land on the west side of the river.

The river freezes over during the winter months.

The present gage datum is 3 feet higher than that of the original gage; but on August 10, 1905, the gage was moved to the west span of the bridge and the datum lowered 2 feet. Gaging conditions at this station are good. The bed of the stream is of gravel, and is free from vegetation.

Discharge measurements of Bighorn River near Hardin, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	J. E. Stewart	419	1,270	3.00	1,800
May 29	do	433	2,360	5.20	9,290
June 21	do	435	3,060	6.80	17,600
August 14	do	432	2,320	5.11	7,340
August 27	Robert Follansbee	431	1,980	4.40	4,100
September 30	J. E. Stewart	422	1,720	3.81	2,560
1908.					
March 27	J. E. Stewart	430	1,550	3.49	1,860
May 20	do	437	2,110	4.80	6,730
June 16	Raymond Richards	447	3,790	7.97	26,400
July 21	do	439	2,830	5.83	11,700
October 13	J. E. Stewart	429	1,780	3.92	3,270

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1907 and 1908.

[J. S. Tupper, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1		2.90	3.55	5.82	7.35	6.35	4.60	3.80	3.60
2		2.90	3.60	5.52	7.40	6.25	4.55	3.75	3.60
3		2.95	3.55	5.52	7.95	6.20	4.50	3.70	3.55
4		3.00	3.58	5.75	8.45	6.15	4.40	3.70	3.55
5		3.00	3.52	5.92	8.50	6.45	4.30	3.70	3.55
6		3.00	3.55	6.28	8.65	6.10	4.20	3.65	3.50
7		3.05	3.55	6.52	8.45	5.95	4.15	3.65	3.50
8		3.05	3.55	6.95	8.35	5.90	4.10	3.70	3.50
9		3.00	3.52	7.30	8.50	5.80	4.10	3.80	3.50
10		2.95	3.52	7.18	8.45	5.65	4.05	3.85	3.50
11		2.98	3.70	7.02	8.15	5.25	4.00	3.85	3.50
12		3.05	4.12	6.82	7.90	5.10	4.00	3.80	3.55
13		3.15	4.50	6.78	7.65	4.95	3.95	3.75	3.55
14		3.10	4.65	6.75	7.45	4.90	3.95	3.75	3.55
15		3.15	4.48	6.70	7.45	4.80	3.90	3.70	3.50
16		3.15	4.38	6.60	7.35	4.80	3.85	3.70	3.50
17		3.45	4.50	6.65	7.30	4.75	3.85	3.70	3.45
18		3.48	5.00	6.50	7.25	4.70	3.85	3.70	3.45
19		3.45	5.12	6.30	7.20	4.70	3.80	3.70	3.40
20		3.45	5.35	6.40	7.15	4.75	3.80	3.70	3.40
21		3.45	5.58	6.80	7.00	4.60	3.80	3.70	3.35
22		3.35	5.75	7.00	6.85	4.55	3.75	3.65	3.35
23		3.25	6.25	7.30	6.75	4.50	3.75	3.60	3.35
24		3.25	6.68	7.05	6.55	4.50	3.70	3.60	3.35
25		3.30	6.72	6.90	6.50	4.45	3.65	3.60	3.40
26		3.32	7.15	6.65	6.45	4.45	3.65	3.60	3.40
27		3.45	7.10	6.60	6.45	4.40	3.65	3.60	3.40
28		3.75	6.98	6.70	6.40	.....	3.65	3.60	3.35
29		3.70	6.40	6.90	6.40	.....	3.75	3.60	3.35
30		3.65	5.98	7.10	6.50	.....	3.80	3.60	3.35
31		.....	5.78	.....	6.45	.....	.....	3.60	.....

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	.....	3.25	3.95	6.00	7.00	5.20	4.10	3.70	3.60
2	.....	3.20	3.90	6.60	7.20	5.20	4.00	3.70	3.60
3	.....	3.15	3.90	6.60	7.30	5.10	4.00	3.80	3.60
4	.....	3.15	3.90	7.40	7.20	4.80	3.90	3.80	3.50
5	.....	3.15	3.80	6.80	7.20	4.90	3.90	3.80	3.50
6	.....	3.10	3.80	6.40	7.20	4.90	3.90	3.90	3.50
7	.....	3.10	4.10	6.40	7.10	4.80	3.80	4.00	3.50
8	.....	3.10	4.30	6.50	7.00	4.70	3.80	4.10	3.50
9	.....	3.15	4.50	6.80	6.80	4.60	3.70	4.10	3.40
10	.....	3.20	4.70	7.10	6.80	4.60	3.70	4.00	3.40
11	.....	3.20	4.70	7.40	6.80	4.50	3.70	4.00	3.30
12	.....	3.30	4.60	8.00	6.70	4.60	3.60	3.90	3.30
13	.....	3.40	4.50	8.60	6.70	4.60	3.60	3.90	3.50
14	.....	3.45	4.40	8.60	6.60	4.60	3.70	4.00	3.30
15	.....	3.50	4.40	8.80	6.50	4.70	3.70	4.00	3.30
16	.....	3.60	4.50	9.10	6.40	5.10	3.80	4.60	3.20
17	.....	3.80	4.50	9.80	6.30	5.00	3.90	3.90	3.20
18	.....	3.90	4.60	9.20	6.20	4.90	3.90	3.90	3.30
19	.....	4.00	4.60	8.40	6.00	4.80	3.80	3.80	3.40
20	.....	4.20	4.80	8.00	5.90	4.80	3.70	3.80	3.40
21	3.50	4.30	4.90	7.80	5.80	4.80	3.70	3.70	3.50
22	3.50	4.50	5.00	7.70	5.70	4.70	3.70	3.70	3.50
23	3.50	4.50	5.00	7.20	5.60	4.70	3.80	3.70	3.50
24	3.50	4.40	4.90	7.00	5.50	4.70	3.90	3.70	3.60
25	3.40	4.40	4.90	6.90	5.40	4.60	3.90	3.70	3.60
26	3.35	4.30	4.80	6.80	5.30	4.60	3.80	3.70	3.60
27	3.30	4.25	4.80	6.70	5.20	4.40	3.80	3.60	3.70
28	3.30	4.15	4.90	6.70	5.20	4.30	3.70	3.60	3.70
29	3.30	4.05	5.00	6.70	5.20	4.30	3.70	3.60	3.70
30	3.30	4.05	5.00	6.90	5.20	4.20	3.70	3.60	3.70
31	3.25	.....	5.40	.....	5.20	4.20	.....	3.60	.....

NOTE.—Probable ice conditions January to March, December, 1907 and January 1 to March 20, December, 1908.

Rating tables for Bighorn River near Hardin, Mont.

APRIL 1 TO JULY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	1,560	4.10	4,930	5.30	9,380	6.80	17,760
3.00	1,800	4.20	5,260	5.40	9,820	7.00	19,140
3.10	2,040	4.30	5,600	5.50	10,280	7.20	20,560
3.20	2,290	4.40	5,950	5.60	10,760	7.40	22,040
3.30	2,550	4.50	6,300	5.70	11,260	7.60	23,580
3.40	2,820	4.60	6,660	5.80	11,780	7.80	25,160
3.50	3,100	4.70	7,030	5.90	12,300	8.00	26,800
3.60	3,390	4.80	7,400	6.00	12,840	8.20	28,450
3.70	3,680	4.90	7,780	6.20	13,980	8.40	30,110
3.80	3,980	5.00	8,170	6.40	15,180	8.60	31,780
3.90	4,290	5.10	8,560	6.60	16,440	8.80	33,460
4.00	4,610	5.20	8,960				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and the 1906 curve. It is fairly well defined between gage heights 2.9 feet and 7.0 feet. Above gage height 5.0 feet it is the same as the 1906 table.

JULY 26 TO NOVEMBER 30, 1907.

3.30	1,440	4.20	3,510	5.00	6,750	5.80	11,170
3.40	1,590	4.30	3,840	5.10	7,260	5.90	11,800
3.50	1,760	4.40	4,190	5.20	7,780	6.00	12,440
3.60	1,950	4.50	4,550	5.30	8,310	6.10	13,090
3.70	2,160	4.60	4,930	5.40	8,850	6.20	13,750
3.80	2,390	4.70	5,340	5.50	9,400	6.30	14,420
3.90	2,640	4.80	5,780	5.60	9,970	6.40	15,100
4.00	2,910	4.90	6,250	5.70	10,560	6.50	15,800
4.10	3,200						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and form of previous curves. It is well defined above gage height 3.6 feet.

Rating tables for Bighorn River near Hardin, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	1,220	4.50	5,300	5.90	12,070	7.60	23,540
3.20	1,380	4.60	5,720	6.00	12,660	7.80	25,040
3.30	1,550	4.70	6,150	6.10	13,260	8.00	26,560
3.40	1,740	4.80	6,590	6.20	13,880	8.20	28,100
3.50	1,960	4.90	7,040	6.30	14,510	8.40	29,660
3.60	2,200	5.00	7,500	6.40	15,150	8.60	31,230
3.70	2,470	5.10	7,970	6.50	15,800	8.80	32,810
3.80	2,770	5.20	8,440	6.60	16,460	9.00	34,400
3.90	3,090	5.30	8,920	6.70	17,130	9.20	36,000
4.00	3,430	5.40	9,410	6.80	17,810	9.40	37,600
4.10	3,780	5.50	9,910	6.90	18,500	9.60	39,200
4.20	4,140	5.60	10,420	7.00	19,200	9.80	40,800
4.30	4,510	5.70	10,950	7.20	20,610		
4.40	4,900	5.80	11,500	7.40	22,060		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908 and is well defined.

Monthly discharge of Bighorn River near Hardin, Mont., for 1907 and 1908.

[Drainage area, 20,700 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	3,830	1,560	2,380	0.115	0.13	142,000	A.
May	20,200	3,160	8,660	.418	.48	532,000	A.
June	21,300	10,400	16,700	.807	.90	994,000	A.
July	32,200	15,100	22,300	1.08	1.24	1,370,000	A.
August	15,400	4,190	7,770	.375	.43	478,000	A.
September	4,930	2,060	2,900	.140	.16	173,000	A.
October	2,520	1,950	2,150	.104	.12	132,000	A.
November	1,950	1,520	1,700	.082	.09	101,000	B.
The period						3,920,000	
1908.							
March 21–31	1,960	1,460	1,720	.083	.03	37,500	B.
April	5,300	1,220	2,740	.132	.15	163,000	A.
May	9,410	2,770	5,620	.271	.31	346,000	A.
June	40,800	12,700	22,600	1.09	1.22	1,340,000	A.
July	21,300	8,440	14,600	.705	.81	898,000	A.
August	8,440	4,140	6,230	.301	.35	383,000	A.
September	3,780	2,200	2,770	.134	.15	165,000	A.
October	3,780	2,200	2,850	.138	.16	175,000	A.
November	2,470	1,380	1,930	.093	.10	115,000	B.
The period						3,620,000	

NOTE.—Discharge estimated for period August 28 to 31, 1907.

LITTLE WIND RIVER AT FORT WASHAKIE, WYO.

This station, which was established October 31, 1908, to obtain data for the use of the Indian Service in connection with irrigation development, is located about three-fourths of a mile below the junction of North and South forks, and 1 mile below Fort Washakie post-office. The river freezes during the winter.

Discharge measurements of Little Wind River at Fort Washakie, Wyo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 8	John Gonin	.....	74	.....	136
October 30	Freeman and Gonin	54	77	1.93	124
December 29[a]	R. L. Cooper	55	103	2.50	92

[a] Ice conditions.

Daily gage height, in feet, of Little Wind River at Fort Washakie, Wyo., for 1908.

[J. J. Guyer, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	1.9	2.0	11	.....	1.85	2.3	21	.....	1.9	2.55
2	.....	1.95	1.8	12	.....	1.75	2.35	22	.....	1.8	2.5
3	.....	1.9	2.3	13	.....	1.75	2.35	23	.....	1.7	2.55
4	.....	1.9	2.3	14	.....	1.95	2.35	24	.....	1.75	2.5
5	.....	1.9	2.25	15	.....	2.05	2.35	25	.....	1.7	2.55
6	.....	1.9	2.2	16	.....	2.15	2.35	26	.....	1.75	2.55
7	.....	1.9	2.2	17	.....	2.1	2.4	27	.....	1.9	2.5
8	.....	1.9	2.25	18	.....	2.05	2.3	28	.....	1.8	2.5
9	.....	1.9	2.25	19	.....	2.0	2.55	29	.....	1.9	2.5
10	.....	1.8	2.3	20	.....	1.9	2.6	30	.....	2.1	2.5
								31	1.9	.....	2.4

NOTE.—Ice conditions probably began November 30.

LITTLE WIND RIVER ABOVE ARAPAHOE, WYO.

This station, which was established May 11, 1906, to determine the amount of water available for irrigation and storage, is located at the government bridge a short distance above the mouth of the Popo Agie River and about one-half mile west of the post-office at Arapahoe. The drainage area is about 650 square miles.

Water is diverted from Little Wind River and various tributaries above the station by the United States Indian Service canal systems, which will eventually irrigate several thousand acres of land. Some of the canals are already in operation.

The datum of the gage has not been changed since the station was established. Fair results have been obtained, but measurements are somewhat affected by the pile bents of the bridge. The river is ice-bound for several months during the winter season.

Discharge measurements of Little Wind River above Arapahoe, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 25	W. B. Freeman	100	122	1.40	304
October 21[a]	....do	57.5	65	.90	106
1908.					
June 15	W. B. Freeman	103	327	3.45	1,620
July 24	J. B. Stewart	102	197	2.05	643
July 25	....do	102	195	2.07	637
August 26	....do	111	169	1.80	446
November 5[a]	W. B. Freeman	58	78	1.09	142

[a] Made by wading.

Daily gage height, in feet, of Little Wind River above Arapahoe, Wyo., for 1907 and 1908.

[Charles H. Kealear, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	0.70	0.65	0.68				1.50	1.00	0.92
2	.72	.65	.60				1.40	1.00	.90
3	.70	.65	.70				1.40	1.00	.92
4	.75	.65	.70				1.35	1.00	.98
5	.75	.70	.70				1.30	1.00	1.00
6	.78	.70	.70				1.20	1.00	.92
7	.80	.70	.70				1.25	1.00	.90
8	.70	.68	.70				1.20	1.00	.90
9	.65	.70	.70			2.30	1.20	1.00	.90
10	.75	.70	.78			2.40	1.20	.95	.82
11	.65	.80	.80			2.25	1.20	.90	.80
12	.68	.82	1.10			2.10	1.20	.90	.90
13	.65	.80	1.25			1.90	1.10	.80	
14	.60	.80	1.10			1.80	1.00	.80	
15	.60	.92	1.05			1.70	1.00	.80	
16	.60	.98	1.05			1.70	1.00	.80	
17	.60	.95	1.25			1.70	1.00	.90	
18	.60	.90	1.50			1.65	1.00	.90	
19	.65	.80	1.55			1.70	1.00	.90	
20	.70	.80	1.50			1.75	1.00	.90	
21	.90	.80				1.70	1.00	.90	
22	.85	.72				1.60	1.00	.90	
23	.80	.80				1.50	1.00	.90	
24	.75	.80				1.50	.95	.90	
25	.70	.80				1.40	.90	.90	
26	.70	.78				1.55	.90	.90	
27	.70	.78				1.70	.90	.98	
28	.60	.75				1.65	.90	1.00	
29	.58	.72				1.60	1.00	1.00	
30	.60	.68				1.50	1.00	1.00	
31	.65					1.50		1.00	
1908.									
1		.8	1.1	1.6	2.85	1.8	1.3		1.1
2		.75	1.1	1.5	2.9	1.75	1.3		1.1
3		.75	1.1	1.4	2.9	1.65	1.3		1.1
4		.75	1.15	1.4	3.15	1.6	1.3		1.1
5		.8	1.25	1.4	3.4	1.6	1.2		1.1
6		.75	1.25	1.35	3.55	1.6	1.15		1.1
7		.8	1.35	1.3	3.15	1.8	1.05		1.1
8		.8	1.55	1.6	2.95	1.8	1.05		1.1
9		.8	1.85	1.65	2.85	1.7	1.05		
10		.7	1.9	1.85	2.85	1.65	1.1		
11		.7	1.65	2.2	2.85	1.8	1.1		
12		.8	1.5	2.75	2.75	1.9	1.1		
13		.8	1.5	2.9	2.7	1.8	1.1		
14		.9	1.6	3.3	2.6	1.95	1.1		
15	1.65	1.0	1.55	3.45	2.6	2.15	1.1		
16	1.7	1.1	1.55	3.55	2.5	2.1	1.1		
17	1.5	1.0	1.4	3.25	2.55	2.0	1.1		
18	1.45	1.0	1.3	3.25	2.45	1.85	1.1		
19	1.2	1.1	1.3	2.95	2.35	1.8	1.1		
20	1.15	1.1	1.35	2.65	2.2	1.8	1.1		
21	.95	1.25	1.4	2.35	2.1	1.8	1.1		
22	1.15	1.35	1.4	2.4	2.0	2.15	1.1		
23	.9	1.3	1.4	2.45	2.0	2.25	1.1		
24	.9	1.3	1.65	2.25	2.05	2.05	1.1		
25	.85	1.25	1.55	2.55	2.0	2.95	1.1		
26	.85	1.2	1.6	2.85	2.0	1.8	1.2		
27	.85	1.1	1.55	3.2	2.0	1.65	1.2		
28	.75	1.1	1.5	3.1	2.0	1.45	1.2		
29	.65	1.1	1.5	2.85	2.0	1.4	1.1		
30	.8	1.1	1.5	2.7	1.9	1.4	1.1		
31	.75		1.5		1.85	1.4			

NOTE.—Ice periods, January 1 to about March 13, 1907, probably November 13, 1907 to March 27, 1908, and after November 8, 1908. Probable backwater effect due to ice during first part of March, 1907 and March 15–22, 1908.

Rating tables for Little Wind River above Arapahoe, Wyo.

JANUARY 1 TO MAY 20, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	50	0.80	125	1.10	230	1.40	365
.60	72	.90	157	1.20	270	1.50	420
.70	97	1.00	192	1.30	315	1.60	480

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is a portion of the rating table published for this station in the 1906 report. It is not well defined.

AUGUST 1, 1907, TO JUNE 10, 1908.

0.60	30	1.10	175	1.60	416	2.10	738
.70	55	1.20	215	1.70	475	2.20	810
.80	80	1.30	260	1.80	536	2.30	884
.90	110	1.40	310	1.90	601	2.40	960
1.00	140	1.50	360	2.00	668		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1907 and the form of the 1908 curve. It is well defined above gage heights 0.9 foot.

JUNE 11 TO SEPTEMBER 30, 1908.

0.70	40	1.50	300	2.30	788	3.10	1,354
.80	62	1.60	350	2.40	856	3.20	1,429
.90	87	1.70	404	2.50	925	3.30	1,505
1.00	115	1.80	461	2.60	994	3.40	1,582
1.10	145	1.90	521	2.70	1,064	3.50	1,660
1.20	178	2.00	585	2.80	1,135	3.60	1,740
1.30	215	2.10	652	2.90	1,207		
1.40	255	2.20	720	3.00	1,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908, and is fairly well defined between gage heights 1 foot and 3.5 feet.

Monthly discharge of Little Wind River above Arapahoe, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March	157	.....	83.0	5,100	C.
April	185	84	117	6,960	B.
May 1–20	450	72	192	7,620	B.
August 9–31	960	310	512	23,400	A.
September	360	110	182	10,800	A.
October	140	80	120	7,380	A.
November 1–12	140	80	112	2,670	C.
1908.					
April	285	55	140	8,330	B.
May	601	175	339	20,800	A.
June	1,700	260	907	54,000	B.
July	1,700	491	943	58,000	A.
August	1,240	255	484	29,800	A.
September	215	130	158	9,400	B.
The period	.....	.....	.....	180,000	

NOTE.—On October 21, 1907, the Indian ditch was diverting about 5 second-feet.

LITTLE WIND RIVER BELOW ARAPAHOE, WYO.

This station, which was established May 11, 1906, to obtain data for use in general studies of run-off, is located at the government bridge, 200 yards below the mouth of Popo Agie River, one-half mile south of the post-office at Arapahoe, and about 6 miles above the junction of Little Wind and Big Wind rivers. Beaver Creek enters from the south between the station and the mouth of the river. The drainage area of Little Wind River at its mouth is about 1,900 square miles.

The records at this station show practically the entire flow of Little Wind River except a small amount of water used for irrigation. Many diversions are made for irrigation from Little Wind and Popo Agie rivers above this station, but opportunities for additional development both for power and irrigation yet remain.

The location of the rod gage has remained unchanged since the establishment of the station, but the bridge was raised 0.17 foot at the gage when the ice went out in the spring of 1908, and all the gage readings for 1908 are low by that amount. They have not been corrected to the old datum.

Conditions at this station are not favorable for accurate results because of the eddies around the pile bents at all stages and the sluggishness of the current at low water. The stream is icebound for several months during the winter season.

Discharge measurements of Little Wind River below Arapahoe, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 25	W. B. Freeman	96	441	2.46	606
October 21	do	93	356	1.60	237
1908.					
June 15	W. B. Freeman	104	857	5.75	4,120
July 25	J. B. Stewart	97.3	521	2.98	1,050
August 26	do	97.8	481	2.60	830
November 5	W. B. Freeman	92.5	336	1.68	290
Do	do			1.68	[a]346
December 26 [b]	R. L. Cooper	95	363	2.00	300

[a] Combined discharges of Little Wind River (discharge 142 second-feet) and Popo Agie River (discharge 204 second-feet) above their junction. These measurements were made by wading and give the combined discharge more accurately than the other measurement of November 5, which was made below the junction and at a poor measuring section.

[b] Ice conditions.

Daily gage height, in feet, of Little Wind River below Arapahoe, Wyo., for 1907 and 1908.

[Charles H. Kealear, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1		1.50	1.78				2.48	1.85	1.68
2		1.50	1.80				2.40	1.80	1.60
3		1.60	1.82				2.32	1.85	1.60
4		1.62	1.80				2.30	1.90	1.70
5		1.70	1.80				2.30	1.90	1.70
6		1.70	1.75				2.30	1.90	1.65
7		1.65	1.70				2.32	1.80	1.60
8	1.75	1.62	1.70				2.30	1.80	1.60
9	1.65	1.60	1.80			3.60	2.25	1.80	1.60
10	1.65	1.65	1.85			3.50	2.20	1.80	1.68
11	1.60	1.85	2.12			3.25	2.20	1.70	1.62
12	1.50	2.00	2.62			3.00	2.10	1.70	1.60
13	1.15	1.90	2.85			2.95	2.10	1.70	
14	1.20	2.05	2.62			2.82	2.00	1.70	
15	1.15	2.25	2.60			2.75	2.00	1.70	
16	1.35	2.32	2.72			2.82	1.90	1.70	
17	1.30	2.30	2.90			2.72	1.85	1.70	
18	1.30	2.22	3.40			2.68	1.80	1.60	
19	1.65	2.10	3.65			2.85	1.80	1.60	
20	1.80	2.00	3.90			2.82	1.80	1.60	
21	2.22	2.00				2.65	1.80	1.60	
22	1.58	1.90				2.60	1.78	1.60	
23	1.90	1.95				2.50	1.72	1.60	
24	1.68	2.00				2.45	1.70	1.60	
25	1.70	2.00				2.42	1.70	1.60	
26	1.68	2.00				2.70	1.70	1.60	
27	1.60	1.95				2.80	1.60	1.70	
28	1.48	1.90				2.70	1.70	1.70	
29	1.50	1.90				2.62	1.75	1.70	
30	1.48	1.82				2.52	1.90	1.70	
31	1.45					2.62		1.70	
1908.									
1		1.1	2.0	3.05	4.4	2.6	2.0		1.75
2		.95	2.05	2.9	4.35	2.5	1.9		1.7
3		1.1	2.1	2.8	4.3	2.5	1.8		1.7
4		1.0	2.2	2.8	4.65	2.4	1.75		1.7
5		1.1	2.3	2.75	5.15	2.35	1.7		1.7
6		1.1	2.3	2.65	5.15	2.3	1.6		1.7
7		1.1	2.5	2.6	4.65	2.5	1.6		1.7
8		1.2	2.85	2.9	4.35	2.4	1.55		1.6
9		1.2	3.25	3.05	4.25	2.3	1.6		
10		1.1	3.25	3.45	4.15	2.35	1.6		
11		1.1	2.9	3.95	4.25	2.45	1.6		
12		1.2	2.65	4.7	4.35	2.7	1.6		
13		1.3	2.65	4.95	4.2	2.8	1.7		
14		1.5	2.75	5.4	4.0	3.15	1.7		
15	2.8	1.7	2.65	5.6	4.0	3.15	1.7		
16	2.8	1.8	2.65	5.7	3.9	3.1	1.7		
17	2.8	1.8	2.5	5.4	3.85	2.85	1.65		
18	2.7	1.95	2.4	5.6	3.6	2.7	1.6		
19	2.7	2.2	2.35	4.7	3.3	2.7	1.6		
20	2.6	2.25	2.55	4.2	3.05	2.7	1.6		
21	2.45	2.45	2.55	3.75	3.0	2.8	1.55		
22	2.5	2.6	2.6	4.1	2.95	3.4	1.5		
23	2.4	2.6	2.75	4.05	2.95	3.35	1.4		
24	2.3	2.5	3.0	3.85	3.05	3.1	1.75		
25	2.35	2.45	2.85	4.25	3.0	2.85	2.0		
26	1.7	2.2	3.05	4.7	2.9	2.7	2.0		
27	1.5	2.1	2.95	5.05	2.9	2.55	1.95		
28	.85	2.05	2.9	4.75	2.8	2.35	1.9		
29	1.0	2.1	2.95	4.45	2.8	2.15	1.8		
30	.95	2.0	3.0	4.3	2.7	2.0	1.65		
31	1.05		3.0		2.7	2.0		1.8	

NOTE.—Ice conditions January 1 to about March 12, 1907, and probably from November 12, 1907, to March 27, 1908, and after November 9, 1908.

Rating tables for Little Wind River below Arapahoe, Wyo.

FOR 1906 TO 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	125	1.90	360	2.70	805	3.50	1,430
1.20	150	2.00	405	2.80	875	3.60	1,520
1.30	175	2.10	450	2.90	945	3.70	1,615
1.40	200	2.20	500	3.00	1,020	3.80	1,710
1.50	225	2.30	555	3.10	1,095	3.90	1,810
1.60	255	2.40	615	3.20	1,175		
1.70	285	2.50	675	3.30	1,255		
1.80	320	2.60	740	3.40	1,340		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 22 discharge measurements made during 1906 and 1907, and is well defined.

FOR 1908.

0.80	100	1.90	445	3.00	1,150	4.20	2,300
.90	120	2.00	490	3.10	1,235	4.40	2,535
1.00	140	2.10	540	3.20	1,320	4.60	2,790
1.10	165	2.20	595	3.30	1,410	4.80	3,050
1.20	190	2.30	655	3.40	1,500	5.00	3,320
1.30	220	2.40	720	3.50	1,590	5.20	3,595
1.40	255	2.50	785	3.60	1,690	5.40	3,875
1.50	290	2.60	850	3.70	1,790	5.60	4,165
1.60	325	2.70	920	3.80	1,890	5.80	4,460
1.70	360	2.80	995	3.90	1,990	6.00	4,760
1.80	400	2.90	1,070	4.00	2,090		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and the form of the 1907 curve, and is fairly well defined. The difference between the 1907 and 1908 ratings is due to a change in gage datum and not because of shifting-channel conditions.

Monthly discharge of Little Wind River below Arapahoe, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 8–31	511		220	10,100	C.
April	567	225	364	21,700	A.
May 1–20	1,810	285	661	26,200	A.
August 9–31	1,520	627	884	40,300	A.
September	663	255	417	24,800	A.
October	360	255	293	18,000	A.
November 1–12	285	255	266	6,330	C.
1908.					
April	850	130	401	23,900	B.
May	1,360	490	908	55,800	B.
June	4,310	850	2,310	137,000	B.
July	3,520	920	1,890	116,000	B.
August	1,500	490	896	55,100	B.
September	490	255	365	21,700	C.
November 1–8	380	325	358	5,680	C.
The period				415,000	

NOTE.—Discharge estimated March 8–12, 1907.

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

This station, which was established August 26, 1907, to determine the amount of unused water in the stream available for additional irrigation and storage, is located at the highway bridge three-eighths of a mile southwest of the post-office at Hudson, Wyo., and a few

hundred yards above the mouth of the stream. The station is below all the tributaries of the Little Popo Agie. The drainage area is about 360 square miles.

For 20 miles or more above this station small ditches take out water to irrigate the valley lands along the stream.

The present chain gage, which was established on June 13, 1908, is located 100 yards downstream from the bridge and the old rod gage. It was set at a different datum from the old gage, but the reading was the same as the reading of the old gage at the time it was located.

High-water measurements were taken from the bridge, but the location is not specially good. There is a bend in the stream a short distance above, the right bank is subject to overflow at high stages, and the bridge itself is sometimes overflowed at extreme stages. However, the results obtained here have been very satisfactory. The flow is affected by ice for several months during the winter season.

Discharge measurements of Little Popo Agie River at Hudson, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of action.	Gage height.		Discharge.
				Old gage.	New gage.	
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
August 26	W. B. Freeman	34	55	2.50	.....	72
October 20	....do	33	48	2.30	.....	44
1908.						
June 13	W. B. Freeman	33.5	151	5.25	5.33	662
June 14	....do	33.5	103	3.90	4.05	341
June 15	....do	33.5	109	4.00	4.18	387
July 26	J. B. Stewart	35	60	2.70	2.80	96
August 25	....do	35	55	.....	2.62	74
November 5	W. B. Freeman	33.5	51	2.47	2.48	61

Daily gage height, in feet, of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908.

[O. S. Riggs, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]						1907.					
1	.....	2.50	2.35	2.30	2.20	16	.....	2.30	2.25	2.22	2.25
2	.....	2.50	2.35	2.30	2.20	17	.....	2.30	2.30	2.32	2.30
3	.....	2.48	2.40	2.30	2.10	18	.....	2.30	2.30	2.30	2.25
4	.....	2.45	2.40	2.30	2.20	19	.....	2.30	2.30	2.22	2.32
5	.....	2.45	2.38	2.30	2.20	20	.....	2.30	2.30	2.30	2.35
6	.....	2.45	2.35	2.30	2.20	21	.....	2.30	2.30	2.35	2.40
7	.....	2.45	2.35	2.30	2.20	22	.....	2.30	2.30	2.20	2.55
8	.....	2.45	2.35	2.30	2.20	23	.....	2.30	2.30	2.20	2.60
9	.....	2.40	2.35	2.30	2.15	24	.....	2.30	2.30	2.20	2.60
10	.....	2.40	2.35	2.30	2.10	25	.....	2.28	2.30	2.32	.....
11	.....	2.35	2.32	2.15	2.30	26	2.50	2.25	2.35	.....	.....
12	.....	2.35	2.25	2.25	2.35	27	2.52	2.25	2.35	2.22	.....
13	.....	2.32	2.25	2.25	2.35	28	2.50	2.30	2.35	2.25	.....
14	.....	2.30	2.25	2.22	2.30	29	2.50	2.30	2.35	2.20	.....
15	.....	2.30	2.25	2.22	2.15	30	2.50	2.35	2.30	2.20	.....
						31	2.50	.....	2.30	.....	.....

[a] Gage heights affected by ice December 11–24, 1907.

Daily gage height, in feet, of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.[a]								
1	2.2	2.6	3.2	3.6	2.6	2.4	2.6	2.55
2	2.2	2.6	3.2	3.7	2.6	2.4	2.5	2.5
3	2.2	2.6	3.15	3.55	2.6	2.35	2.9	2.55
4	2.2	2.7	3.1	3.65	2.6	2.3	2.8	2.55
5	2.2	2.7	3.1	3.85	2.5	2.3	2.8	2.5
6	2.25	2.7	3.05	3.95	2.5	2.3	2.8	2.5
7	2.3	2.75	3.05	3.7	2.5	2.3	2.6	2.5
8	2.2	2.8	3.2	3.6	2.5	2.3	2.6	2.5
9	2.3	3.0	3.4	3.5	2.5	2.3	2.6	2.5
10	2.3	3.0	3.6	3.4	2.5	2.3	2.6	2.4
11	2.3	2.8	3.5	3.45	2.5	2.3	2.6	.....
12	2.35	2.75	3.6	3.65	2.7	.....	2.6	.....
13	2.4	2.7	4.7	3.6	2.6	2.3	2.6	.....
14	2.5	2.8	4.25	3.5	2.8	2.3	2.6	.....
15	2.45	2.85	4.35	3.4	3.9	2.3	2.55	.....
16	2.55	2.8	4.6	3.3	2.9	2.3	2.6	.....
17	2.55	2.75	4.35	3.25	2.7	2.3	2.6	.....
18	2.6	2.75	5.05	3.1	2.65	2.3	2.6	.....
19	2.6	2.8	4.05	3.1	2.65	2.3	2.6	.....
20	2.65	3.0	3.8	3.0	2.7	2.3	2.6	.....
21	2.7	2.95	3.6	2.9	2.7	2.3	2.6	.....
22	2.75	2.95	3.7	2.9	2.8	2.3	2.55	.....
23	2.75	3.15	3.75	2.9	2.75	2.3	2.55	.....
24	2.7	3.25	3.6	2.8	2.7	2.3	2.55	.....
25	2.7	3.1	3.65	2.8	2.6	2.4	2.55	.....
26	2.6	3.1	3.8	2.8	2.6	2.6	2.6	.....
27	2.5	3.15	4.0	2.8	2.5	2.6	2.6	.....
28	2.55	3.15	3.8	2.75	2.5	2.55	2.55	.....
29	2.6	3.25	3.6	2.8	2.4	2.55	2.55	.....
30	2.6	3.3	3.5	2.7	2.4	2.6	2.6	.....
31	.....	3.25	.....	2.7	2.4	.....	2.55	.....

[a] Ice conditions December 11, 1907, to about February 29, 1908, and after November 11, 1908.

Rating tables for Little Popo Agie River at Hudson, Wyo.

AUGUST 26, 1907, TO JUNE 13 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	27	2.80	117	3.50	240	4.20	420
2.20	35	2.90	135	3.60	282	4.30	443
2.30	45	3.00	154	3.70	305	4.40	466
2.40	56	3.10	174	3.80	328	4.50	489
2.50	70	3.20	195	3.90	351	4.60	512
2.60	85	3.30	216	4.00	374	4.70	535
2.70	100	3.40	238	4.10	397		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1907–8 and is well defined between gage heights 2.3 feet and 5.0 feet.

JUNE 14 TO NOVEMBER 10, 1908.

2.30	44	3.20	167	4.10	360	5.00	577
2.40	53	3.30	187	4.20	383	5.10	602
2.50	63	3.40	207	4.30	406	5.20	628
2.60	73	3.50	227	4.40	429	5.30	654
2.70	84	3.60	248	4.50	453	5.40	681
2.80	97	3.70	270	4.60	477	5.50	708
2.90	111	3.80	292	4.70	502	5.60	735
3.00	128	3.90	314	4.80	527	5.70	763
3.10	147	4.00	337	4.90	552		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907–8 and is well defined between gage heights 2.4 feet and 5.3 feet.

Monthly discharge of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 26–31	73	70	70.5	839	A.
September	70	40	51.3	3,050	A.
October	56	40	47.0	2,890	A.
November	50	31	41.2	2,450	B.
December 1–24	35	25	28.3	1,350	D.
1908.					
April	108	35	66.9	3,980	A.
May	216	85	138	8,480	A.
June	749	164	296	17,600	A.
July	326	84	181	11,100	A.
August	314	53	81.4	5,010	A.
September	73	44	49.5	2,950	B.
October	111	63	74.9	4,610	A.
November 1–10	68	53	63.5	1,260	A.
The period				55,000	

SHOSHONE RIVER AT CODY, WYO.

This station, which is located at the highway bridge 1 mile northeast of Cody, Wyo., was established April 26, 1902, to obtain data to be used in connection with the Shoshone reclamation project.

The principal tributaries are the North and South forks, which unite 8 miles above Cody to form the Shoshone. The drainage area above the gaging station is 1,400 square miles, but the entire run-off from this area does not pass the station as a number of private irrigation canals divert water from the Shoshone and its branches above the station. These canals irrigate about 35,000 acres of land. Below Cody irrigation has been carried on quite extensively by means of private canal systems that serve about 45,000 acres.

The conditions for obtaining accurate discharge data are good. Ice does not affect the flow at this station, as the river is kept open by springs which enter the river a short distance above the gage. The gage datum has remained unchanged.

Discharge measurements of Shoshone River at Cody, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. feet.*	*Feet.*	*Sec.-ft.*
April 18	G. F. Harley	134	393	3.11	1,120
April 20	do	126	363	2.83	895
May 20	do	180	752	5.30	4,700
June 24	Downey and Blakeslee	179	813	5.40	5,140
June 27	G. L. Blakeslee	178	798	5.50	5,250
July 3	Ahern and Craig	196	1,170	6.80	9,930
July 23	P. S. Craig	196	1,070	6.10	7,250
October 11	J. Ahern	118	331	2.70	537
December 4	do	118	240	2.20	298
1908.					
April 15	G. L. Blakeslee	148	430	3.80	1,720
April 18	Blakeslee and Downey	152	488	3.75	1,840
April 21	A. C. Downey	158	576	4.45	3,010
April 24	G. L. Blakeslee	145	465	3.70	1,670
April 28	do	138	398	3.15	930
May 9	do	163	594	4.45	2,900
May 16	do	148	453	3.60	1,400
Do	do	148	453	3.60	1,420
June 12	do	195	876	6.00	6,860
October 16	J. E. Stewart	148	468	3.68	1,360

Daily gage height, in feet, of Shoshone River at Cody, Wyo., for 1907 and 1908.

[S. C. Bovard, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.8	1.95	1.95	2.5	2.7	4.35	6.5	5.4	3.6	3.0	2.5	2.5
2	1.8	1.9	1.95	2.65	2.7	5.55	7.0	5.2	3.6	3.0	2.45	2.4
3	1.7	1.7	1.85	2.65	2.65	5.2	7.1	5.2	3.5	3.0	2.45	2.4
4	1.65	1.6	1.9	2.6	2.7	5.1	8.0	5.5	3.5	3.0	2.45	2.35
5	1.95	1.65	1.85	2.7	2.75	5.4	7.5	5.0	3.5	3.0	2.35	2.3
6	1.9	1.85	2.05	2.55	2.9	5.6	6.9	4.9	3.5	3.0	2.35	2.7
7	1.9	1.95	2.1	2.5	2.9	5.95	7.1	5.0	3.5	3.0	2.35	2.45
8	1.85	1.95	2.0	2.4	2.9	5.8	6.8	4.9	3.5	3.0	2.4	2.4
9	1.8	1.95	2.0	2.5	3.2	5.5	7.0	4.9	3.5	3.0	2.35	2.35
10	1.7	1.9	2.0	2.8	3.65	5.0	6.8	4.8	3.4	2.9	2.35	2.3
11	1.8	1.9	2.0	3.15	4.0	5.2	6.8	4.3	3.4	2.9	2.2	2.3
12	1.85	1.9	1.95	3.05	4.4	5.5	6.5	4.1	3.4	2.85	2.05	2.45
13	1.7	2.0	1.9	3.1	3.9	5.5	6.5	4.1	3.4	2.85	2.2	2.4
14	1.7	2.0	1.85	3.35	3.8	5.0	6.4	4.1	3.4	2.85	2.2	2.35
15	1.65	2.0	1.9	3.5	3.6	5.0	6.2	4.3	3.4	2.85	2.4	2.2
16	1.7	2.0	1.95	3.4	4.3	4.8	5.4	4.1	3.3	2.8	2.5	2.2
17	1.75	2.0	2.0	3.45	4.8	4.6	5.4	4.0	3.3	2.8	2.5	2.3
18	1.8	2.0	2.0	3.1	5.0	5.4	5.4	4.0	3.2	2.8	2.5	2.25
19	1.9	2.1	2.95	3.0	5.5	5.7	6.0	4.0	3.1	2.65	2.45	2.0
20	1.9	2.1	3.15	2.9	5.6	6.2	6.2	3.95	3.1	2.65	2.4	2.0
21	1.8	2.05	3.0	2.8	5.5	6.1	6.2	3.7	3.05	2.65	2.4	2.0
22	1.9	2.1	2.8	2.9	5.2	6.2	6.0	3.7	3.05	2.65	2.4	2.0
23	2.0	2.1	2.55	3.0	5.3	6.0	6.1	3.7	3.0	2.6	2.4	2.1
24	1.9	2.15	2.5	3.1	5.3	5.5	6.0	3.7	3.0	2.6	2.4	2.1
25	1.85	2.0	2.45	2.9	4.5	5.5	6.0	3.8	3.0	2.6	2.4	2.25
26	1.85	2.0	2.3	2.9	4.3	5.2	5.8	3.7	3.0	2.6	2.5	2.4
27	1.8	1.9	2.1	2.75	4.0	5.6	5.6	3.8	3.0	2.6	2.5	2.4
28	1.8	1.9	2.2	2.7	3.9	6.4	5.5	3.8	3.0	2.6	2.5	2.4
29	1.9	.....	2.25	2.65	3.9	6.6	5.6	3.7	3.0	2.6	2.4	2.4
30	1.9	.....	2.2	2.7	4.0	6.6	5.6	3.7	3.0	2.5	2.5	2.4
31	1.9	.....	2.4	.....	4.1	.....	5.6	3.8	.....	2.5	.....	2.4
1908.												
1	2.35	2.2	2.1	2.1	3.25	5.3	6.3	4.9	3.5	3.0	2.9	2.4
2	2.35	2.1	2.1	2.1	3.7	4.7	6.2	4.7	3.3	2.9	3.0	2.4
3	2.35	2.1	2.1	2.2	4.0	4.5	6.4	4.7	3.25	3.0	3.0	2.4
4	2.25	2.1	2.1	2.5	3.85	4.5	6.9	4.5	3.2	3.0	3.0	2.4
5	2.2	2.1	2.1	2.4	3.7	4.3	6.6	4.4	3.25	3.1	3.0	2.3
6	2.2	2.1	2.0	2.4	4.0	4.25	6.0	4.3	3.25	3.2	3.0	2.3
7	2.2	2.1	2.0	2.3	4.45	4.55	6.1	4.3	3.25	3.2	3.0	2.3
8	2.4	2.1	2.0	2.2	4.6	4.75	6.1	4.2	3.2	3.45	3.0	2.35
9	2.4	2.1	2.1	2.3	4.4	5.0	6.9	4.2	3.2	3.4	2.9	2.35
10	2.4	2.1	2.1	2.75	4.3	5.2	6.7	4.1	3.1	3.3	2.9	2.35
11	2.4	2.1	2.1	3.05	3.95	5.7	6.4	4.3	3.1	3.25	2.9	2.35
12	2.35	2.1	2.2	3.3	3.7	6.05	6.3	4.15	3.1	3.2	2.7	2.35
13	2.4	2.1	2.2	3.6	3.6	6.0	6.3	3.9	3.1	3.0	2.7	2.35
14	2.4	2.1	2.2	3.8	3.7	6.4	6.5	4.0	3.4	3.0	2.7	2.35
15	2.4	2.1	2.3	3.8	3.6	6.7	6.2	4.5	3.2	3.4	2.7	2.35
16	2.35	2.1	2.4	3.7	3.5	6.4	6.1	3.9	3.2	3.6	2.7	2.25
17	2.4	2.1	2.9	3.8	3.55	6.5	5.9	3.9	3.1	3.25	2.7	2.25
18	2.4	2.1	2.5	3.8	3.45	6.0	5.6	3.8	3.3	3.2	2.7	2.25
19	2.4	2.1	2.4	4.1	3.4	5.5	5.5	4.95	3.2	3.2	2.7	2.2
20	2.4	2.1	2.1	4.35	3.8	5.2	5.6	4.5	3.1	3.1	2.7	2.2
21	2.35	2.1	2.1	4.05	3.7	5.15	5.5	4.1	3.0	2.9	2.7	2.2
22	2.4	2.1	2.1	4.3	4.0	5.0	5.4	4.1	3.0	2.9	2.7	2.2
23	2.35	2.1	2.1	4.0	3.75	4.8	5.4	4.1	2.9	2.9	2.7	2.2
24	2.4	2.2	2.1	3.7	3.9	5.0	5.3	4.1	3.0	2.9	2.5	2.2
25	2.2	2.2	2.1	3.5	3.9	5.6	5.2	3.9	3.0	2.9	2.4	2.2
26	2.2	2.2	2.15	3.3	4.0	6.1	5.1	3.8	3.0	2.9	2.4	2.2
27	2.2	2.1	2.1	3.2	3.95	6.7	5.1	3.7	3.0	2.9	2.4	2.2
28	2.25	2.2	2.1	3.15	4.05	5.6	5.1	3.7	3.0	2.9	2.4	2.2
29	2.2	2.2	2.1	3.15	4.1	5.5	5.4	3.7	3.0	2.9	2.4	2.2
30	2.2	.....	2.1	3.2	4.1	5.4	5.0	3.6	3.0	2.9	2.4	2.2
31	2.2	.....	2.1	.....	4.9	.....	4.9	3.6	.....	2.9	.....	2.2

Rating tables for Shoshone River at Cody, Wyo.

JANUARY 1 TO JULY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	160	2.90	930	4.20	2,520	6.00	6,930
1.70	190	3.00	1,020	4.30	2,680	6.20	7,620
1.80	225	3.10	1,110	4.40	2,850	6.40	8,350
1.90	265	3.20	1,210	4.50	3,030	6.60	9,150
2.00	310	3.30	1,310	4.60	3,220	6.80	10,000
2.10	360	3.40	1,420	4.70	3,420	7.00	10,900
2.20	415	3.50	1,540	4.80	3,630	7.20	11,800
2.30	475	3.60	1,660	4.90	3,850	7.40	12,800
2.40	540	3.70	1,790	5.00	4,080	7.60	13,800
2.50	610	3.80	1,920	5.20	4,570	7.80	14,800
2.60	685	3.90	2,060	5.40	5,100	8.00	15,800
2.70	765	4.00	2,210	5.60	5,670		
2.80	845	4.10	2,360	5.80	6,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during this period and the general form of previous curves at low stages and is well defined.

JULY 26 TO DECEMBER 31, 1907.

2.00	195	2.90	725	3.80	1,780	4.70	3,320
2.10	230	3.00	820	3.90	1,930	4.80	3,530
2.20	270	3.10	920	4.00	2,080	4.90	3,750
2.30	315	3.20	1,030	4.10	2,240	5.00	3,980
2.40	365	3.30	1,140	4.20	2,400	5.20	4,580
2.50	425	3.40	1,260	4.30	2,570	5.40	5,140
2.60	490	3.50	1,380	4.40	2,750	5.60	5,750
2.70	560	3.60	1,510	4.50	2,930	5.80	6,380
2.80	640	3.70	1,640	4.60	3,120		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and the form of the subsequent curve and is fairly well defined.

JANUARY 1 TO JULY 31, 1908.

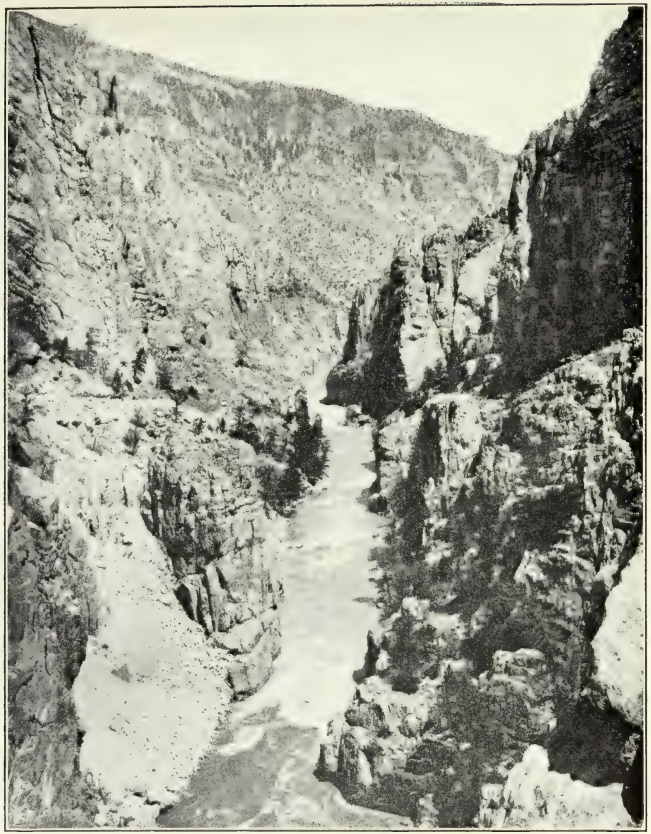
2.00	180	3.10	890	4.20	2,430	5.60	5,660
2.10	210	3.20	1,000	4.30	2,610	5.80	6,270
2.20	250	3.30	1,110	4.40	2,800	6.00	6,930
2.30	300	3.40	1,230	4.50	3,000	6.20	7,620
2.40	350	3.50	1,360	4.60	3,200	6.40	8,350
2.50	410	3.60	1,490	4.70	3,410	6.60	9,150
2.60	475	3.70	1,630	4.80	3,620	6.80	10,000
2.70	545	3.80	1,780	4.90	3,840	7.00	10,900
2.80	620	3.90	1,930	5.00	4,070		
2.90	700	4.00	2,090	5.20	4,560		
3.00	790	4.10	2,260	5.40	5,090		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seventeen discharge measurements made during 1907–8 and is well defined.

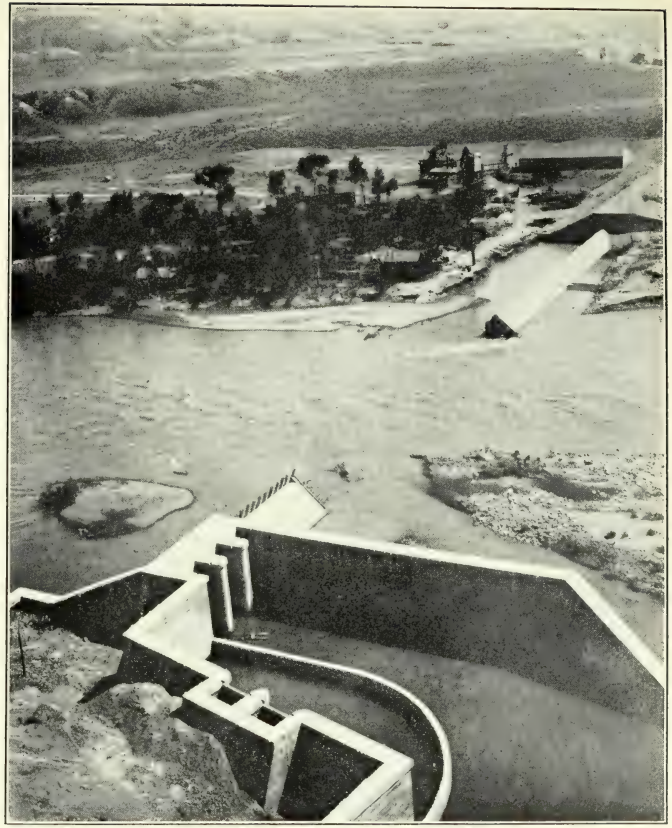
AUGUST 1 TO DECEMBER 31, 1908.

2.20	190	3.00	620	3.80	1,540	4.60	3,070
2.30	225	3.10	700	3.90	1,700	4.70	3,300
2.40	265	3.20	790	4.00	1,870	4.80	3,530
2.50	310	3.30	890	4.10	2,050	4.90	3,770
2.60	360	3.40	1,000	4.20	2,240	5.00	4,010
2.70	420	3.50	1,120	4.30	2,440		
2.80	480	3.60	1,250	4.40	2,640		
2.90	550	3.70	1,390	4.50	2,850		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the general form of the previous curve and is not well defined.



A. BOX CANYON IMMEDIATELY BELOW SHOSHONE DAM SITE, SHOSHONE RIVER, WYOMING.



B. CORBETT TUNNEL, CORBETT DIVERSION DAM, SHOSHONE PROJECT, WYOMING.

Monthly discharge of Shoshone River at Cody, Wyo., for 1907 and 1908.

[Drainage area, 1,480 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	310	175	234	0.158	0.18	14,400	A.
February	387	160	291	.197	.21	16,200	A.
March	1,160	245	442	.299	.34	27,200	A.
April	1,540	540	926	.626	.70	55,100	A.
May	5,670	725	2,520	1.70	1.96	155,000	A.
June	9,150	2,760	5,630	3.80	4.24	335,000	A.
July	15,800	5,100	8,280	5.59	6.44	509,000	A.
August	5,440	1,640	2,690	1.82	2.10	165,000	A.
September	1,510	820	1,120	.757	.84	66,600	A.
October	820	425	641	.433	.50	39,400	B.
November	425	212	366	.247	.28	21,800	B.
December	560	195	325	220	.25	20,000	B.
The year	15,800	160	1,960	1.32	18.04	1,420,000	
1908.							
January	350	250	310	.209	.24	19,100	A.
February	250	210	218	.147	.16	12,500	B.
March	700	180	246	.166	.19	15,100	A.
April	2,700	210	1,170	.791	.88	69,600	A.
May	3,840	1,060	1,970	1.33	1.53	121,000	A.
June	9,570	2,520	5,380	3.64	4.06	320,000	A.
July	10,400	3,840	6,680	4.51	5.20	411,000	A.
August	3,890	1,250	2,200	1.49	1.72	135,000	A.
September	1,120	550	744	.503	.56	44,300	B.
October	1,250	550	707	.478	.55	43,500	B.
November	620	265	449	.303	.34	26,700	C.
December	265	190	219	.148	.17	13,500	D.
The year	10,400	180	1,690	1.14	15.60	1,230,000	

SHOSHONE RIVER AT CORBETT DAM, WYO.

This station, which is located 8 miles below Cody, Wyo., at the Corbett diversion dam built by the United States Reclamation Service, was established April 20, 1908.

The dam is a reinforced concrete structure of the buttressed type, having on the upstream side a deck 2½ feet thick, sloping 1 to 1, and supported by buttresses 2 feet thick, spaced 14 feet on centers. It raises the low-water elevation of the river 10.2 feet. The length between abutments is 400 feet. (See Pl. IX, *B*.)

Sage Creek, the only important tributary that enters between this station and that at Cody, drains only about 25 square miles. During the irrigating season of 1908 about 75 second-feet were diverted above the dam through Corbett tunnel and used on the Shoshone reclamation project.

The gage is situated 40 feet above the crest of the dam, and it reads the height of the water above the crest.

Daily gage height, in feet, of Shoshone River at Corbett dam, Wyo., for 1908.

[John A. Fleming, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.80	2.02	2.80	1.60	0.80	0.60	0.56
2	.....	1.02	1.60	2.90	1.65	.70	.60	.56
3	.....	1.28	1.62	3.10	1.60	.70	.60	.56
4	.....	1.00	1.70	3.35	1.40	.70	.65	.56
5	.....	1.00	1.50	3.45	1.30	.70	.70	.56
6	.....	1.22	1.45	2.50	1.35	.70	.70	.56
7	.....	1.52	1.60	2.40	1.30	.70	.70	.55
8	.....	1.72	1.65	2.90	1.25	.70	.81	.55
9	.....	1.58	2.00	3.00	1.20	.65	.73	.55
10	.....	1.45	2.20	3.10	1.15	.65	.70	.55
11	.....	1.22	2.55	2.80	1.30	.65	.68	.54
12	.....	1.08	2.75	2.75	1.15	.65	.66	.54
13	.....	1.12	2.75	2.80	1.00	.65	.65	.54
14	.....	1.00	3.00	3.00	1.10	.75	.65	.54
15	.....	.98	3.30	2.70	1.40	.70	.80	(a)
16	.....	.98	3.10	2.60	1.10	.65	.89	.....
17	.....	.92	3.10	2.50	1.05	.65	.77	.....
18	.....	.90	2.65	2.30	.95	.75	.68	.....
19	.....	.88	2.25	2.10	1.70	.65	.66	.....
20	1.50	1.18	2.00	2.20	1.40	.60	.63	.....
21	1.56	.92	2.00	2.20	1.20	.60	.60	.....
22	1.45	.92	1.95	2.10	1.20	.60	.60	.....
23	1.31	1.25	1.75	2.10	1.15	.55	.59	.....
24	1.10	1.02	1.80	1.95	1.15	.55	.63	.....
25	.95	1.20	2.20	1.90	1.10	.60	.61	.....
26	.90	1.35	2.65	1.90	1.00	.70	.60	.....
27	.82	1.25	3.00	1.80	.90	.65	.60	.....
28	.76	1.40	2.30	1.90	.85	.60	.63	.....
29	.72	1.25	2.10	1.95	.85	.70	.61	.....
30	.75	1.30	2.50	1.75	.85	.65	.60	.....
31	.....	1.72	.....	1.65	.90	.....	.58	.....

(a) Sluice gates open; no water flowing over dam.

Rating table for Shoshone River at Corbett dam, Wyo., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	420	1.30	1,980	2.10	4,090	2.90	6,770
.60	580	1.40	2,220	2.20	4,390	3.00	7,150
.70	750	1.50	2,465	2.30	4,700	3.10	7,550
.80	930	1.60	2,720	2.40	5,020	3.20	7,960
.90	1,120	1.70	2,980	2.50	5,350	3.30	8,380
1.00	1,320	1.80	3,245	2.60	5,690	3.40	8,810
1.10	1,530	1.90	3,520	2.70	6,040	3.50	9,240
1.20	1,750	2.00	3,800	2.80	6,400	3.60	9,680

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It was computed from data for weir model described in Water-Supply Paper 200, page 90.

Monthly discharge of Shoshone River at Corbett dam, Wyo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 20–30	2,620	786	1,520	33,200
May	3,030	930	1,720	106,060
June	8,380	2,340	4,630	276,000
July	9,020	2,850	5,360	330,000
August	2,980	1,020	1,770	109,000
September	930	500	689	41,000
October	1,100	548	687	42,200
November 1–14	516	484	502	13,900
The period	.....	.....	.....	951,000

SOUTH FORK OF SHOSHONE RIVER AT MARQUETTE, WYO.

This station, which was established April 26, 1903, to determine the amount of water available for the Shoshone project of the United States Reclamation Service, is located at the highway bridge at Marquette, 12 miles west of Cody. It was discontinued during 1904, but was again established during 1905. On April 4, 1906, the station was moved $1\frac{3}{4}$ miles downstream to a point about one-half mile above the Shoshone dam. The station was discontinued September 30, 1908.

The drainage area is 500 square miles, but the entire run-off from this area does not pass the station, as about 10,000 acres of land are irrigated from this stream and all the water is diverted above the gaging station.

The conditions for obtaining accurate discharge data are good except during the winter months, when the gage heights are affected by ice.

Discharge measurements of South Fork of Shoshone River at Marquette, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of Section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 21	Downey and Blakeslee	144	464	4.20	3,070
June 25	G. L. Blakeslee	144	346	3.65	1,870
July 5	do	144	600	5.50	4,450
July 9	Downey and Russell	144	464	4.55	3,180
July 20	Blakeslee and Fraser	144	441	3.90	2,680
August 3	do	144	365	3.55	1,880
August 14	A. C. Downey	144	233	2.70	914
August 23	G. L. Blakeslee	138	188	2.20	639
August 29	Robert Follansbee	124	188	2.30	520
1908.					
April 20	A. C. Downey	144	292	2.75	1,130
Do	G. L. Blakeslee	144	306	2.75	1,100
April 29	do	129	165	1.80	364
May 18	do	130	180	1.88	413
June 10	do	144	306	3.45	1,790
October 15	J. E. Stewart	124	130	2.09	287

Daily gage height, in feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	1.05	1.3	1.4	2.9	4.7	3.8	2.35	1.7	1.25
2	1.05	1.4	1.4	.....	5.0	3.65	2.2	1.7	1.25
3	1.05	1.35	1.4	3.35	5.2	3.55	2.2	1.7	1.2
4	1.1	1.35	1.4	3.1	6.1	3.45	2.15	1.7	1.2
5	1.05	1.25	1.4	3.5	5.5	3.3	2.3	1.7	1.2
6	1.1	1.3	1.5	3.85	5.65	3.15	2.3	1.7	1.2
7	1.1	1.3	1.55	4.1	5.6	3.3	2.45	1.7	1.2
8	1.05	1.2	1.55	3.85	4.7	3.35	2.3	1.65	1.2
9	1.05	1.25	1.65	3.55	4.75	3.2	2.1	1.65	1.2
10	1.05	1.4	2.15	3.25	4.5	3.2	2.05	1.65	1.1
11	1.05	1.45	2.4	3.2	4.3	3.0	2.05	1.6	1.0
12	1.05	1.5	2.65	3.6	4.2	2.75	2.05	1.55	.....
13	1.05	1.5	2.1	3.5	4.3	2.8	2.0	1.55	.....
14	1.0	1.8	1.95	3.15	4.0	2.7	2.0	1.55	.....
15	1.0	1.9	2.0	3.05	3.9	2.9	2.0	1.7	.....

Daily gage height, in feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
16	1.05	1.9	2.6	.....	3.5	2.65	1.95	1.55	.....
17	.....	1.7	2.85	2.8	3.3	2.6	1.9	1.4	.....
18	1.05	1.7	3.0	3.3	3.2	2.65	1.9	1.4	.....
19	1.5	1.55	.....	3.8	3.8	2.7	1.9	1.4	.....
20	1.55	1.4	3.5	4.2	3.9	2.5	1.9	1.4	.....
21	1.55	1.4	3.45	4.3	3.8	2.4	1.85	1.4	.....
22	1.4	1.4	3.4	4.4	3.9	2.3	1.8	1.4	.....
23	1.3	1.5	3.5	3.9	3.9	2.2	1.75	1.35	.....
24	1.3	.....	3.15	3.6	4.0	2.3	1.75	1.35	.....
25	1.3	1.5	2.9	3.7	4.05	2.35	1.75	1.3	.....
26	4.4	1.5	.....	3.0	3.8	2.4	1.75	1.3	.....
27	.....	1.35	2.5	3.6	3.8	2.3	1.7	1.3	.....
28	.....	1.4	2.35	4.4	4.0	2.4	1.75	1.3	.....
29	.....	1.4	2.4	4.9	4.7	2.3	1.7	1.3	.....
30	.....	1.4	2.4	.....	4.05	2.45	1.7	1.3	.....
31	.....	.....	2.5	.....	3.9	2.4	.....	1.25	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1908.							1908.						
1	1.25	1.75	3.05	4.15	3.3	2.0	16	2.25	2.0	4.2	3.85	2.45	1.75
2	1.2	2.05	2.85	3.9	3.2	1.95	17	2.2	1.95	4.05	3.95	2.45	1.75
3	1.3	2.35	2.9	4.35	3.0	1.95	18	2.2	1.9	3.7	3.8	2.5	1.9
4	1.35	2.25	2.85	4.9	2.9	1.9	19	2.55	1.9	3.45	3.45	3.2	1.8
5	1.35	2.05	2.65	4.65	2.8	1.9	20	2.75	1.95	3.15	3.5	2.8	1.75
6	1.4	2.25	2.50	3.85	2.8	1.9	21	2.9	1.95	3.05	3.7	2.8	1.75
7	1.35	2.8	2.8	3.95	2.75	1.85	22	2.65	2.0	2.95	3.6	2.7	1.75
8	1.35	3.05	2.95	4.15	2.7	1.85	23	2.4	2.75	2.75	3.65	2.65	1.75
9	1.35	2.8	3.15	4.35	2.7	1.85	24	2.2	2.25	2.95	3.45	2.6	1.75
10	1.45	2.65	3.45	4.6	2.65	1.85	25	2.05	2.45	3.65	3.4	2.5	1.75
11	1.55	2.35	3.6	4.45	2.7	1.8	26	1.9	2.6	4.0	3.35	2.45	1.75
12	1.8	2.15	4.0	4.25	2.5	1.8	27	1.8	2.45	4.55	3.4	2.3	1.75
13	2.1	2.15	3.85	4.3	2.45	1.85	28	1.8	2.65	3.65	3.4	2.1	1.75
14	2.8	2.1	4.15	4.15	2.6	1.85	29	1.8	2.45	3.45	3.4	1.95	1.8
15	2.3	1.95	4.75	4.0	2.8	1.8	30	1.8	2.65	3.95	3.3	2.2	1.8
							31	.....	3.3	.....	3.25	2.1	.....

NOTE.—Ice conditions March 26–31, November 12 to December 31, 1907. Gage heights August 15 to November 11, 1907, and June 5 to September 30, 1908, are unreliable owing to settling of gage and uncertainty of gage datum.

Gage heights for October and November, 1907, were furnished by D. W. Cole, construction engineer, United States Reclamation Service.

Rating tables for South Fork of Shoshone River at Marquette, Wyo.

APRIL 4, 1906, TO JUNE 21, 1907, AND APRIL 1 TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	95	1.90	413	2.90	1,220	3.90	2,590
1.00	115	2.00	463	3.00	1,340	4.00	2,740
1.10	137	2.10	518	3.10	1,460	4.20	3,060
1.20	161	2.20	578	3.20	1,590	4.40	3,380
1.30	188	2.30	648	3.30	1,720	4.60	3,710
1.40	218	2.40	723	3.40	1,860	4.80	4,050
1.50	251	2.50	808	3.50	2,000	5.00	4,390
1.60	287	2.60	900	3.60	2,140		
1.70	326	2.70	1,000	3.70	2,290		
1.80	368	2.80	1,110	3.80	2,440		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 19 discharge measurements made during 1906 and is well defined between gage heights 1.0 foot and 3.5 feet.

JUNE 22 TO AUGUST 14, 1907.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1907.				1907.				1907.			
1		3,360	2,260	11		2,900	1,210	21		2,480	
2		3,770	2,000	12		2,780	955	22	3,250	2,630	
3		4,050	1,880	13		2,960	1,000	23	2,420	2,600	
4		5,300	1,760	14		2,570	914	24	1,900	2,940	
5		4,450	1,560	15		2,470		25	1,960	2,780	
6		4,680	1,380	16		1,960		26	1,100	2,410	
7		4,720	1,560	17		1,740		27	1,830	2,360	
8		3,360	1,630	18		1,650		28	2,940	2,660	
9		3,380	1,440	19		2,490		29	3,630	3,680	
10		3,140	1,440	20		2,680		30	3,490	2,670	
								31		2,400	

NOTE.—These discharges were obtained by the indirect method for shifting channels. Discharges for July 4 and 7 were estimated from a comparison of hydrographs of stations at Cody and Marquette, Wyo.

Monthly discharge of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January			80	0.160	0.18	4,920	C.
February			100	.200	.21	5,550	C.
March	269	115	161	.322	.37	9,900	B.
April	413	174	243	.486	.54	14,500	B.
May	2,000	218	844	1.69	1.95	51,900	B.
June	3,630	1,100	2,120	4.24	4.73	126,000	B.
July	5,300	1,650	3,030	6.06	6.99	186,000	B.
August	2,260		915	1.83	2.11	56,300	C.
September			381	.762	.85	22,700	C.
October			218	.436	.50	13,400	C.
November			124	.248	.28	7,380	C.
December			110	.220	.25	6,760	C.
The year			694	1.38	18.96	505,000	
1908.							
April	1,220	161	481	.962	1.07	28,600	B.
May	1,720	347	713	1.43	1.65	43,800	B.
June 1–5	1,400	950	1,180	2.36	.44	11,700	B.

NOTE.—Owing to the unreliability of the gage heights the monthly estimates of flow for January and February, and August 14 to December 31, 1907, are made by taking 34 per cent of the discharge at the station at Cody, Wyo. These estimates are fairly approximate.

LITTLE MUDDY RIVER DRAINAGE BASIN.

DESCRIPTION.

Little Muddy River is a prairie stream that receives the drainage from an area of about 1,000 square miles—35 miles from north to south and 30 miles from east to west—in the center of Williams County, the northwestern county of North Dakota. It flows southward and joins the Missouri at Williston. About one-sixth of the whole area of the Little Muddy is drained by Stony Creek, a tributary

which enters a few rods above its mouth. Altitudes in this basin range from 1,850 to 2,400 feet above sea level. The area is entirely without trees or shrubs, but is everywhere covered with rank prairie grass. The mean annual rainfall is about 15 inches.

Only a minor fraction of the run-off from this drainage area is carried by the stream. The entire region is deeply covered by glacial drift and there are many hollows and pools that receive the run-off and hold it till it evaporates, except when the rains are very heavy and long continued or the annual rainfall unusually great.

The headwaters of the main stream and the tributaries afford some storage sites, but only in shallow reservoirs from which evaporation is rapid. Several such reservoirs holding from 10 acre-feet to 200 each are already in use, and a number of small irrigation plants with ditches carrying 2 or 3 second-feet or less are in operation.

About 50 filings for water rights, aggregating 2,000 second-feet, were made on this stream and its tributaries prior to the passage by the legislature in 1905 of the revised irrigation code, but many of these claims have been abandoned and nearly all call for quantities greater than are ever available except sometimes during a few days of spring flood.

About 12,000 acres in this valley are included in the Williston reclamation project, 8,500 acres being under canals already completed. Owing to the variability in annual discharge of the Little Muddy, which even with complete storage would probably not furnish an adequate supply in dry years, the water for the Williston project is obtained by pumping from the Missouri.

One station has been maintained in this basin: Little Muddy River, near Williston, N. Dak., 1904 to 1908.

LITTLE MUDDY RIVER NEAR WILLISTON, N. DAK.

This station, which is located about 7 miles north of Williston, N. Dak., at the center of sec. 19, T. 155 N., R. 100 W., was established February 4, 1904, to determine the value of the stream for irrigation.

Camp Creek, a small tributary, comes in from the right a few rods below the station. The drainage area above this point is about 800 square miles.

The gage datum has not been changed since the station was established. Changes in channel conditions have been slight. Low-stage estimates of discharge are correct within a few second-feet, although the flow is so small that a change of one-tenth of a foot in gage height indicates a very large percentage change in flow. As only a few discharge measurements have been made at high water the high-stage rating table is not perfectly checked, but the monthly estimates at such times are fairly good.

Discharge measurements of Little Muddy River near Williston, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	J. H. Turner	22	30.5	3.30	59.5
July 12	do	8.4	8.9	2.57	8.9
August 5	Follansbee and Chandler	8.1	7.3	2.44	7.3
1908.					
May 24	G. H. Ellis		327	3.50	96
May 26	do		67	3.60	103
June 5[a]	do		81	4.65	144
August 30	do	16	30.3	2.20	6.0
September 9	do	3.3	5.6	2.20	5.3
September 13	do	4.0	5.6	2.20	5.2

[a] Measurement made during flood; gage height fluctuated rapidly. Recorded gage height was probably at or near crest height, but measurement was made 1 mile downstream and before flood arrived. Measurement rejected.

NOTE.—These measurements were made at various sections.

Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1907 and 1908.

[W. O. Hollar, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.										
1			4.65	3.25	3.0	2.8	2.5	2.4	2.5	2.5
2			4.75	3.35	3.0	2.8	2.4	2.4	2.5	2.5
3			4.85	3.25	3.0	2.7	2.4	2.4	2.5	2.5
4		4.6	4.8	3.05	2.9	2.7	2.4	2.4	2.5	2.5
5			4.75	3.1	2.9	2.7	2.4	2.4	2.5	2.5
6			4.85	3.2	2.8	2.7	2.3	2.4	2.5	2.5
7			4.7	3.25	2.8	2.7	2.3	2.4	2.5	2.5
8			4.8	3.35	2.9	2.7	2.3	2.4	2.5	2.5
9			4.9	3.45	3.0	2.6	2.3	2.5	2.5	2.5
10			4.9	3.5	3.0	2.6	2.3	2.5	2.5	2.5
11			5.05	3.6	3.0	2.6	2.3	2.5	2.5	2.5
12			5.0	3.6	3.0	2.6	2.3	2.5	2.5	2.5
13			4.9	3.45	3.0	2.5	2.3	2.5	2.5	2.5
14			5.25	3.3	3.0	2.5	2.3	2.5	2.5	2.5
15			5.4	3.3	3.0	2.5	2.3	2.5	2.5	2.5
16			5.65	3.3	3.0	2.5	2.3	2.5	2.5	2.5
17			5.85	3.3	3.0	2.5	2.3	2.5	2.5	.....
18			5.9	3.3	2.9	2.5	2.3	2.5	2.5	.....
19			5.6	3.3	2.9	2.5	2.3	2.5	2.5	.....
20			5.3	3.2	2.8	2.5	2.3	2.6	2.5	.....
21			5.3	3.2	2.8	2.5	2.3	2.6	2.5	.....
22		3.6	5.45	3.1	2.7	2.5	2.3	2.6	2.5	.....
23		4.1	5.7	3.0	2.7	2.5	2.3	2.6	2.5	.....
24	3.2	4.4	5.55	3.1	2.7	2.4	2.3	2.6	2.5	.....
25	3.3	4.45	5.3	3.2	2.7	2.5	2.3	2.5	2.5	.....
26			5.05	3.2	2.7	2.5	2.3	2.5	2.5	.....
27			4.7	3.2	2.7	2.5	2.3	2.5	2.5	.....
28			4.05	3.2	2.8	2.5	2.4	2.5	2.5	.....
29			3.7	3.1	2.8	2.5	2.4	2.5	2.5	.....
30			3.45	3.1	2.8	2.5	2.4	2.5	2.5	.....
31			.....	3.0	.....	2.5	2.4	.....	2.5	.....
1908.										
1			2.85	3.0	3.0	2.8	2.3	2.2	2.4	2.4
2			2.85	2.9	3.0	2.7	2.2	2.2	2.4	2.3
3			2.85	2.8	2.9	2.65	2.2	2.2	2.4	2.3
4			4.25	2.8	3.0	2.5	2.2	2.2	2.3	2.3
5			6.65	2.8	3.85	2.5	2.2	2.2	2.3	2.3
6			5.7	2.7	4.3	2.5	2.2	2.2	2.3	2.3
7			5.2	2.7	4.1	2.5	2.2	2.2	2.3	2.3
8			4.85	2.7	3.85	2.5	2.2	2.2	2.3	2.3
9			4.65	2.7	3.7	2.5	2.2	2.2	2.3	2.3
10			4.1	2.7	3.45	2.5	2.2	2.2	2.3	.....

Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.										
11				3.9	2.7	3.4	2.5	2.2	2.2	2.3
12				3.8	2.7	3.15	2.5	2.2	2.2	2.3
13				3.65	2.7	2.95	2.5	2.2	2.2	2.3
14				3.6	2.8	2.8	2.5	2.2	2.2	2.4
15				3.35	2.8	2.8	2.5	2.2	2.2	2.4
16				3.15	2.9	2.8	2.5	2.2	2.2	2.4
17				3.1	2.9	2.7	2.5	2.2	2.2	2.4
18				2.9	2.9	2.7	2.4	2.2	2.2	2.4
19				2.8	2.9	3.05	2.4	2.2	2.2	2.4
20				2.8	2.9	3.35	2.4	2.2	2.2	2.4
21				2.8	3.05	3.55	2.4	2.2	2.2	2.5
22			2.8	2.7	3.2	3.4	2.4	2.2	2.2	2.5
23			2.8	2.7	3.45	3.4	2.4	2.2	2.3	2.5
24			2.7	3.1	3.65	3.3	2.4	2.2	2.3	2.5
25			2.7	3.1	3.8	3.2	2.4	2.2	2.3	2.5
26			2.8	3.15	3.8	3.1	2.4	2.2	2.4	2.5
27			2.8	3.2	3.7	3.0	2.3	2.2	2.4	2.4
28			2.9	3.25	3.55	2.9	2.3	2.2	2.4	2.4
29			2.75	3.2	3.35	2.9	2.3	2.2	2.4	2.4
30			2.85	3.05	3.3	2.8	2.3	2.2	2.4	2.4
31			2.85	.....	3.2	.....	2.3	2.2	.....	2.4

NOTE.—Ice conditions January 1 to March 31, 1907, November 17, 1907, to March 21, 1908, and after November 9, 1908.

Rating table for Little Muddy River near Williston, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	5	3.30	61	4.40	405	5.50	930
2.30	6	3.40	74	4.50	450	5.60	980
2.40	7	3.50	92	4.60	495	5.70	1,035
2.50	9	3.60	114	4.70	540	5.80	1,090
2.60	12	3.70	140	4.80	585	5.90	1,145
2.70	16	3.80	170	4.90	630	6.00	1,200
2.80	21	3.90	203	5.00	680	6.20	1,310
2.90	27	4.00	239	5.10	730	6.40	1,430
3.00	34	4.10	277	5.20	780	6.60	1,550
3.10	42	4.20	318	5.30	830	6.80	1,670
3.20	51	4.30	361	5.40	880		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1908, and is well defined between gage heights 2.2 feet and 4.0 feet. Above gage height 4.0 feet the rating curve is based on one measurement at gage height 5.4 feet.

Monthly discharge of Little Muddy River near Williston, N. Dak., for 1907 and 1908.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	1,140	83	696	0.870	0.97	41,400	B.
May	114	34	59.0	.074	.09	3,630	A.
June	34	16	26.2	.033	.04	1,560	B.
July	21	7	11.5	.014	.02	707	C.
August	9	6	6.4	.0080	.009	394	C.
September	12	7	9.0	.011	.01	536	C.
October	9	9	9.0	.011	.01	553	C.
November 1–16	9	9	9.0	.011	.007	286	C.
The period						49,100	

Monthly discharge of Little Muddy River near Williston, N. Dak., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
March 22-31	27	16	20.9	0.026	0.01	415	B.
April	1,580	16	214	.268	.30	12,700	B.
May	170	16	48.1	.060	.07	2,960	A.
June	361	16	74.2	.093	.10	4,420	A.
July	21	6	8.7	.011	.01	535	C.
August	6	5	5.0	.0062	.007	307	C.
September	7	5	5.4	.0068	.008	321	C.
October	9	6	7.1	.0089	.01	437	C.
November 1-9	7	6	6.1	.0076	.003	109	C.
The period						22,200	

LITTLE MISSOURI RIVER DRAINAGE BASIN.

DESCRIPTION.

Little Missouri River rises in northeastern Wyoming, flows northward and slightly to the east through the southeastern corner of Montana and the northwestern corner of South Dakota into North Dakota, parallels the western boundary of North Dakota, near the middle of which it turns sharply and flows eastward to Missouri River at the Fort Berthold Indian Reservation. Its length by general course is about 270 miles and its drainage area comprises somewhat more than 10,000 square miles.

The Little Missouri has many small tributaries that are dry during the greater part of the year. Its only important tributary is Beaver Creek, which flows northward nearly parallel to the river for 130 miles through eastern Montana and enters the river at its big bend. This creek drains about one-fifth of the entire basin.

The upper portion of the area is mountainous, but the river flows for the most part through the high prairies—a rolling country with occasional ranges of steep hills carrying a little timber. Near the mouth of the river its altitude is 1,725 feet above sea level, but most of the basin in North Dakota is between 2,000 and 3,300 feet above sea. In the portion of the basin in North Dakota the mean annual rainfall is 12 to 16 inches, more than half of which falls in the months of May, June, and July; hence flood flows are most likely to occur in the river at two periods—in March or April, when the snow goes off, and in late May, June, or early July, following heavy precipitation. The flow is, however, very irregular. All the lower course of the river is through badlands, and as a result the stream is very flashy, rising suddenly after violent storms when there is a quick run-off from the hillsides. In a single day its discharge sometimes increases from a few score second-feet to as many thousands.

On account of the great fluctuations in the flow of the stream, the unfavorable nature of the topography, and the absence of any rock in place that would afford a really good foundation for structures, no projects for the utilization or diversion of the main stream in its lower portion in any extensive manner, either for power or irrigation, have ever been found.

The following stations have been maintained in this basin:

Little Missouri River at Alzada, Mont., 1904–1906.
Little Missouri River at Camp Crook, S. Dak., 1903–1906.
Little Missouri River at Medora, N. Dak., 1903–1908.

LITTLE MISSOURI RIVER AT MEDORA, N. DAK.

This station, which is located at Medora, N. Dak., where the river is crossed by the Northern Pacific Railway, was established May 12, 1903, to determine the value of the stream for irrigation. The drainage area above this point is 5,780 square miles.

The gage datum has not been changed. The channel is very unstable and changes in depth at every flood. Satisfactory rating curves can not be made without very frequent discharge measurements, and the monthly estimates are liable to large errors; but as these errors are in considerable part compensating, the annual totals are supposed to be fairly good.

The station was discontinued October 31, 1908.

Discharge measurements of Little Missouri River at Medora, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29	T. R. Atkinson	330	1,810	12.08	14,000
July 28	Chandler and Atkinson	148	378	4.79	1,020
1908.					
May 15	P. N. Ford	98	221	3.74	366
May 27	do	278	782	7.13	3,890
August 14[a]	E. F. Chandler	53.5	39	3.46	70
August 15[a]	do	54	42	3.50	81
August 16[a]	do	80	87	4.28	267

[a] Made by wading.

Daily gage height, in feet, of Little Missouri River at Medora, N. Dak., for 1907 and 1908.

[Carl Anderson and Agnus Pelette, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	4.5	4.0	3.4	10.0	4.7	4.8	3.3	3.1	2.8	2.8
2	.....	.....	4.1	3.9	3.4	9.2	4.6	4.8	3.3	3.1	2.8	2.7
3	.....	.....	4.2	3.9	3.4	8.4	4.6	4.6	3.2	3.2	2.8	2.7
4	.....	.....	4.4	3.8	3.4	7.6	4.6	4.4	3.2	3.2	2.8	2.7
5	.....	.....	4.7	3.8	3.4	6.7	4.6	4.2	3.2	3.2	2.8	2.7
6	.....	.....	5.0	3.7	3.4	6.0	4.7	4.0	3.2	3.1	2.8	2.7
7	.....	.....	5.3	3.7	3.4	5.8	4.6	3.9	3.1	3.1	2.8	2.7
8	.....	.....	5.2	3.7	3.4	5.7	4.5	3.8	3.1	3.1	2.8	2.7
9	.....	.....	5.2	3.7	3.4	5.8	4.5	3.8	3.1	3.1	2.8	2.7
10	.....	.....	5.1	3.8	3.4	5.8	4.7	3.7	3.1	3.1	2.8	2.7
11	.....	.....	5.0	3.8	3.4	5.9	5.1	3.6	3.1	3.0	2.8	2.7
12	.....	.....	5.0	3.8	3.4	5.9	5.7	3.5	3.0	3.0	2.8	2.7
13	.....	.....	4.8	3.8	3.4	6.0	5.8	3.5	3.0	3.0	2.8	2.7
14	.....	.....	4.9	3.8	3.3	6.0	6.1	3.4	3.0	3.0	2.8	2.7
15	.....	.....	5.2	3.8	3.3	6.1	6.9	3.4	3.0	3.0	2.8	.....
16	.....	.....	5.4	3.7	3.3	6.1	6.0	3.4	3.0	3.0	2.8	.....
17	.....	8.0	5.4	3.7	3.3	6.2	5.5	3.3	3.0	3.0	2.8	.....
18	.....	8.9	5.4	3.6	3.3	6.4	4.7	3.3	3.0	3.0	2.8	.....
19	.....	9.3	5.4	3.6	3.3	6.2	6.3	3.3	3.0	3.0	2.8	.....
20	.....	8.7	5.4	3.5	3.3	5.8	6.3	3.3	3.1	2.9	2.8	.....
21	.....	7.8	5.5	3.5	3.3	5.6	6.7	3.2	3.1	2.9	2.8	.....
22	.....	7.1	5.6	3.5	3.3	5.4	6.1	3.2	4.0	2.9	2.8	.....
23	.....	6.9	5.6	3.5	3.3	12.8	6.0	3.2	4.3	2.9	2.8	.....
24	.....	6.4	5.3	3.5	3.4	[a]14.5	5.6	3.2	3.9	2.9	2.8	.....
25	.....	5.9	5.0	3.5	3.5	10.0	7.0	3.2	3.6	2.9	2.8	.....
26	.....	5.7	4.7	3.5	10.0	8.0	8.5	3.1	3.4	2.9	2.8	.....
27	.....	5.6	4.5	3.5	11.3	6.2	5.6	3.1	3.3	2.9	2.8	.....
28	.....	5.0	4.3	3.5	11.5	5.6	4.8	3.2	3.2	2.9	2.8	.....
29	.....	.....	4.1	3.5	12.3	4.8	4.7	3.4	3.2	2.8	2.8	.....
30	.....	.....	4.0	3.4	12.8	4.7	4.7	3.4	3.2	2.8	2.8	.....
31	2.1	.....	4.0	.....	11.0	.....	4.7	3.3	.....	2.8	.....	2.3
1908.												
1	.....	.....	.....	4.6	4.1	7.8	5.5	3.4	3.2	4.0	.....	.....
2	.....	.....	.....	4.6	4.1	8.0	4.5	3.2	3.2	3.8	.....	.....
3	.....	.....	.....	4.6	4.0	8.1	4.4	3.2	3.2	3.6	.....	.....
4	.....	.....	.....	4.8	4.0	8.5	4.3	3.2	3.2	3.4	.....	.....
5	.....	.....	.....	4.5	4.0	9.0	4.0	3.2	3.2	3.2	.....	.....
6	.....	.....	.....	4.4	4.0	10.3	4.0	3.2	3.2	3.2	.....	.....
7	.....	.....	.....	4.3	4.0	10.1	3.9	3.2	3.1	3.2	.....	.....
8	.....	.....	.....	3.9	4.0	9.0	3.9	3.2	3.0	3.8	.....	.....
9	.....	.....	.....	3.6	4.0	8.2	3.9	3.2	3.0	4.0	.....	.....
10	.....	.....	.....	3.6	3.8	7.7	3.9	3.2	3.0	4.0	.....	.....
11	.....	.....	.....	3.5	3.7	7.0	3.9	3.2	3.0	3.8	.....	.....
12	.....	.....	.....	3.4	3.6	6.5	3.9	3.2	3.0	3.8	.....	.....
13	.....	.....	.....	3.3	3.4	5.8	3.7	3.2	3.8	3.6	.....	.....
14	.....	.....	6.0	3.3	3.2	5.5	3.7	3.2	3.4	3.7	.....	.....
15	.....	.....	5.8	3.2	3.7	5.4	3.6	3.6	3.2	3.9	.....	.....
16	.....	.....	5.6	3.2	3.6	5.3	3.9	4.5	3.0	3.9	.....	.....
17	.....	.....	5.4	3.2	3.5	5.0	4.0	5.0	3.0	4.0	.....	.....
18	.....	.....	5.2	3.2	3.4	4.8	4.2	4.6	3.8	4.0	.....	.....
19	.....	.....	4.8	3.2	3.4	4.7	4.0	4.0	3.4	4.4	.....	.....
20	.....	.....	5.0	3.2	3.9	4.7	4.0	3.7	3.1	5.0	.....	.....
21	.....	.....	5.2	3.1	4.6	4.6	4.0	3.4	3.0	5.9	.....	.....
22	.....	.....	4.4	3.1	5.2	4.5	4.0	3.4	3.0	6.0	.....	.....
23	.....	.....	4.2	3.0	5.4	4.3	5.2	3.4	3.0	5.8	.....	.....
24	.....	.....	4.0	3.0	6.0	4.2	4.7	3.4	3.0	4.7	.....	.....
25	.....	.....	3.9	2.9	6.5	4.8	4.0	3.4	3.4	4.4	.....	.....
26	.....	.....	3.8	2.9	7.1	5.2	4.0	3.4	4.0	4.3	.....	.....
27	.....	.....	3.7	4.9	7.1	5.8	3.8	3.4	3.6	4.2	.....	.....
28	.....	.....	3.6	4.6	7.1	5.9	3.7	3.4	3.5	4.1	.....	.....
29	.....	.....	3.5	4.3	7.0	5.8	3.7	3.4	4.0	3.9	.....	.....
30	.....	.....	3.6	4.2	7.2	5.6	3.6	3.3	4.2	3.7	.....	.....
31	.....	.....	3.8	.....	7.3	.....	3.5	3.2	.....	3.4	.....	.....

[a] Maximum recorded gage height was 16.0 feet at 7 a. m.

NOTE.—Probable ice conditions January 1 to February 16, 1907, December 15, 1907, to March 13, 1908.

Rating tables for Little Missouri River at Medora, N. Dak.

MARCH 23, 1906, TO MAY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	29	4.60	503	5.90	1,295	7.40	3,000
3.40	54	4.70	547	6.00	1,380	7.60	3,280
3.50	85	4.80	592	6.10	1,470	7.80	3,580
3.60	118	4.90	639	6.20	1,565	8.00	3,890
3.70	152	5.00	688	6.30	1,665	8.20	4,210
3.80	187	5.10	740	6.40	1,770	8.40	4,530
3.90	223	5.20	795	6.50	1,880	8.60	4,850
4.00	260	5.30	855	6.60	1,990	8.80	5,170
4.10	298	5.40	920	6.70	2,100	9.00	5,500
4.20	337	5.50	990	6.80	2,220	9.20	5,840
4.30	377	5.60	1,060	6.90	2,340	9.40	6,180
4.40	418	5.70	1,135	7.00	2,470		
4.50	460	5.80	1,215	7.20	2,730		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on fifteen discharge measurements made during 1905–6, and is fairly well defined below gage height 9.0 feet.

MAY 26, 1907, TO JULY 23, 1908.

2.70	4	4.00	490	5.30	1,500	7.20	3,990
2.80	8	4.10	550	5.40	1,600	7.40	4,330
2.90	14	4.20	615	5.50	1,700	7.60	4,690
3.00	24	4.30	680	5.60	1,810	7.80	5,070
3.10	44	4.40	750	5.70	1,920	8.00	5,460
3.20	80	4.50	820	5.80	2,030	8.20	5,860
3.30	120	4.60	890	5.90	2,150	8.40	6,260
3.40	165	4.70	970	6.00	2,270	8.60	6,660
3.50	210	4.80	1,050	6.20	2,520	8.80	7,080
3.60	260	4.90	1,130	6.40	2,780	9.00	7,500
3.70	315	5.00	1,220	6.60	3,060		
3.80	370	5.10	1,310	6.80	3,350		
3.90	430	5.20	1,400	7.00	3,660		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907–8, and is only approximate.

JULY 24 TO OCTOBER 31, 1908.

3.00	16	3.80	139	4.60	410	5.40	930
3.10	23	3.90	162	4.70	465	5.50	1,010
3.20	34	4.00	186	4.80	520	5.60	1,090
3.30	46	4.10	213	4.90	580	5.70	1,170
3.40	60	4.20	243	5.00	640	5.80	1,250
3.50	77	4.30	277	5.10	710	5.90	1,340
3.60	96	4.40	316	5.20	780	6.00	1,430
3.70	117	4.50	360	5.30	850		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and upon the general form of the preceding curves. It is only approximate.

Monthly discharge of Little Missouri River at Medora, N. Dak., for 1907 and 1908.

[Drainage area, 5,780 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 17–28	6,010	688	2,890	0.500	0.22	68,800	B.
March	1,060	260	671	.116	.13	41,300	B.
April	260	54	142	.025	.03	8,450	B.
May	15,500	29	2,500	.433	.50	154,000	B.
June	19,000	970	4,160	.720	.80	248,000	B.
July	6,460	820	1,820	.315	.36	112,000	B.
August	1,050	44	290	.050	.06	17,800	C.
September	680	24	115	.020	.02	6,840	C.
October	80	8	29.5	.0051	.006	1,810	D.
November	8	8	8.0	.0014	.002	476	D.
December 1–14	8	4	4.3	.00074	.0004	119	D.
The period						660,000	
1908.							
March 14–31	2,270	210	936	.162	.11	33,400	B.
April	1,130	14	383	.066	.07	22,800	B.
May	4,160	80	1,280	.221	.25	78,700	B.
June	10,200	615	3,320	.574	.64	198,000	B.
July	1,700	77	473	.082	.09	29,100	B.
August	640	34	94.5	.016	.02	5,810	C.
September	243	16	56.9	.0098	.01	3,390	C.
October	1,430	34	294	.051	.06	18,100	C.
The period						389,000	

KNIFE RIVER DRAINAGE BASIN.

DESCRIPTION.

Knife River rises in the northeastern portion of Billings County, N. Dak., and flows eastward to Missouri River at Stanton, N. Dak., 90 miles in a direct line. It drains a basin whose greatest width is 40 miles and whose area comprises about 2,500 square miles. One-fifth of this basin is drained by the chief tributary, Spring Creek, which enters the Knife about 20 miles above its mouth.

Altitudes range from 1,700 to 2,500 feet above sea level. The mean annual rainfall varies from 15 to 17 inches. There are no forests and only a few scattered trees along the streams.

Through most of the year the flow is small, but owing to the steep slopes of the sides of the valley there are occasional sudden floods after heavy rains.

The land in the lower portion of the valley is very favorably located for irrigation if the flood waters can be stored, but no really economical localities for storage have yet been found.

One station has been maintained in this basin:

Knife River at Broncho, N. Dak., 1903 to 1908.

KNIFE RIVER AT BRONCHO, N. DAK.

This station, which is located at C. D. Smith's ranch, in the SE. ¼ sec. 4, T. 142 N., R. 90 W., the former site of the post-office of Broncho, N. Dak., was established on May 29, 1903, to determine the amount of water available for irrigation.

Spring Creek enters about 15 miles below the station and Elm Creek one-half mile above. The drainage area is 1,260 square miles.

The station was originally 2 miles farther down the river, but it was moved to its present location March 23, 1905, and since that time the gage datum has been unchanged. The drainage areas at the two locations are practically identical, the area at the lowest point being perhaps about 5 square miles greater.

The channel conditions at this point do not change perceptibly. Sufficient discharge measurements at high stages have not yet been made to check the rating curve satisfactorily, but it is approximately defined.

Discharge measurements of Knife River at Broncho, N. Dak. in 1904–1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	E. F. Chandler	87	616	11.32	2,010
July 2[a]	Raymond Richards	16	23	.86	13.5
August 6[a]	do		6.2	.71	2.9
August 21[a]	E. F. Chandler		9.0	.85	5.6
August 24[a]	do		7.4	.80	4.2
October 29[a]	L. L. Wilcox		10	.88	5.2
1905.					
March 23	E. F. Chandler	10	8.6	3.89	18
July 3	Chandler and Richards	10.5	8.4	3.6	9.8
July 5	do	52	261	7.51	632
Do	do	47	233	6.92	486
August 5	Raymond Richards	31.5	40	4.05	44
August 26	do	11	2.9	3.35	2
October 17	do	9	6.3	3.37	3.1
1906.					
April 12	E. F. Chandler	34	97	4.08	35.4
Do[b]	do	13	11	4.08	39.0
August 27[a]	do	17	28	3.87	13.5
1907.					
April 13	T. R. Atkinson	40	33.2	4.40	51.1
May 30	do	23.5	13.0	3.80	18.6
July 27[a]	Chandler and Atkinson	18	31.4	4.04	30.3
1908.					
May 30	P. N. Ford	34	74.8	4.30	61
August 10[a]	E. F. Chandler	9	5.0	3.34	2.1

[a] Made by wading. [b] Made 3 miles above the gage.

Daily gage height, in feet, of Knife River at Broncho, N. Dak., for 1907 and 1908.

[C. D. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	5.4	4.0	3.8	3.9	3.6	3.6	3.4	3.5	3.5
2	.....	5.3	4.0	3.8	3.8	3.5	3.6	3.4	3.5	3.5
3	.....	5.2	4.0	3.8	3.6	3.4	3.6	3.4	3.5	3.5
4	.....	6.3	4.0	3.8	3.6	3.4	3.5	3.3	3.5	3.5
5	.....	6.1	4.0	3.8	3.6	3.4	3.5	3.3	3.5	3.5
6	.....	5.4	3.9	3.8	3.6	3.4	3.5	3.3	3.5	3.5
7	.....	4.9	3.9	3.8	3.5	3.4	3.5	3.3	3.5	3.5
8	.....	4.7	3.9	3.8	3.5	3.4	3.4	3.3	3.5	3.5
9	.....	4.6	3.9	3.8	3.4	3.4	3.4	3.3	3.5	3.5
10	.....	4.5	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.5
11	.....	4.5	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.6
12	.....	4.4	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.6
13	.....	4.4	3.9	3.9	3.4	3.4	3.3	3.3	3.5	3.6
14	.....	4.3	3.9	3.9	3.5	3.4	3.3	3.4	3.5	3.6
15	.....	4.3	3.9	3.9	3.5	3.4	3.3	3.4	3.5	.....
16	.....	4.2	3.9	3.9	3.5	3.4	3.3	3.4	3.5	.....
17	.....	4.2	3.9	4.0	3.6	3.4	3.3	3.4	3.5	.....
18	.....	4.2	3.9	4.0	3.6	3.4	3.3	3.4	3.5	.....
19	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
20	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
21	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
22	.....	4.2	3.8	3.9	3.7	3.4	3.3	3.5	3.5	.....
23	.....	4.2	3.8	5.7	3.7	3.4	3.3	3.5	3.5	.....
24	.....	4.2	3.8	4.7	3.7	4.1	3.3	3.5	3.5	.....
25	.....	4.2	3.8	4.6	3.6	3.9	3.3	3.5	3.5	.....
26	.....	4.1	3.8	4.2	3.6	3.8	3.3	3.5	3.5	.....
27	.....	4.1	3.9	4.1	4.1	3.8	3.4	3.5	3.5	.....
28	.....	4.1	3.9	4.1	3.9	3.8	3.4	3.5	3.5	.....
29	.....	4.1	3.9	4.0	3.9	3.7	3.4	3.5	3.5	.....
30	.....	4.0	3.9	3.9	3.8	3.6	3.4	3.5	3.5	.....
31	.....	.....	3.9	.....	3.7	3.6	.....	3.5	.....	.....
1908.										
1	.....	4.7	4.1	4.2	3.8	3.4	3.4	3.4	3.5	.....
2	.....	4.6	4.0	4.2	3.8	3.4	3.4	3.4	3.5	.....
3	.....	4.6	3.8	4.6	3.8	3.4	3.4	3.4	3.5	.....
4	.....	4.7	3.8	5.3	3.8	3.4	3.4	3.4	3.5	.....
5	.....	7.35	3.8	8.75	3.8	3.4	3.4	3.4	3.5	.....
6	.....	6.5	3.8	7.95	3.8	3.4	3.4	3.4	3.5	.....
7	.....	5.4	3.7	7.35	3.7	3.4	3.4	3.4	3.5	.....
8	.....	5.2	3.7	6.4	3.6	3.4	3.4	3.4	3.5	.....
9	.....	5.2	3.7	6.0	3.6	3.4	3.4	3.4	3.5	.....
10	.....	4.6	3.6	5.3	3.6	3.4	3.3	3.4	3.5	.....
11	.....	4.5	3.6	4.8	3.6	3.4	3.3	3.4	3.4	.....
12	6.1	4.5	3.7	4.3	3.5	3.4	3.3	3.4	3.4	.....
13	7.1	4.5	3.7	4.2	3.5	3.4	3.3	3.4	3.4	.....
14	7.7	4.6	3.7	4.1	3.5	3.4	3.3	3.4	3.4	.....
15	6.9	4.6	3.7	4.1	3.4	3.4	3.2	3.4	3.4	.....
16	6.4	4.4	3.7	4.0	3.4	3.4	3.2	3.4	3.4	.....
17	5.65	4.2	3.9	3.9	3.5	3.4	3.2	3.4	3.4	.....
18	5.5	4.1	4.1	3.8	3.5	3.4	3.1	3.4	3.4	.....
19	5.5	4.0	4.1	4.25	3.6	3.4	3.1	3.4	3.4	.....
20	6.3	4.0	4.2	5.4	3.6	3.4	3.2	3.4	3.4	.....
21	6.0	3.9	4.5	4.95	3.6	3.4	3.2	3.4	3.4	.....
22	6.3	3.9	6.15	4.4	3.5	3.4	3.3	3.7	.....	.....
23	6.2	3.9	7.15	4.15	3.4	3.4	3.3	3.7	.....	.....
24	6.0	3.8	7.35	4.05	3.4	3.5	3.3	3.6	.....	.....
25	5.5	3.8	7.4	4.0	3.4	3.5	3.3	3.5	.....	.....
26	5.0	3.8	6.5	4.2	3.4	3.5	3.3	3.5	.....	.....
27	4.9	3.9	5.7	4.2	3.5	3.5	3.3	3.5	.....	.....
28	4.8	4.4	4.7	4.0	3.5	3.5	3.3	3.5	.....	.....
29	4.8	4.3	4.4	3.95	3.5	3.5	3.3	3.5	.....	.....
30	4.8	4.2	4.2	3.9	3.5	3.4	3.4	3.5	.....	.....
31	4.7	.....	4.2	.....	3.5	3.4	.....	3.5	.....	.....

NOTE.—Probable ice conditions December 15, 1907, to March 11, 1908, and after November 21, 1908.

Rating tables for Knife River at Broncho, N. Dak.

FOR 1904.

[Indirect method for shifting channels used for 1904.]

FOR 1905–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	0	4.60	95	6.10	336	8.20	775
3.20	1	4.70	108	6.20	354	8.40	821
3.30	2	4.80	122	6.30	373	8.60	867
3.40	4	4.90	136	6.40	392	8.80	913
3.50	7	5.00	151	6.50	411	9.00	960
3.60	10	5.10	166	6.60	431	9.20	1,010
3.70	14	5.20	181	6.70	451	9.40	1,060
3.80	19	5.30	197	6.80	471	9.60	1,110
3.90	25	5.40	216	6.90	492	9.80	1,160
4.00	32	5.50	232	7.00	513	10.00	1,210
4.10	40	5.60	249	7.20	555	11.00	1,460
4.20	49	5.70	266	7.40	597	12.00	1,710
4.30	59	5.80	283	7.60	641	13.00	2,060
4.40	70	5.90	300	7.80	685	14.00	2,310
4.50	82	6.00	318	8.00	729		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905–1908 and is well defined between gage heights 3.2 feet and 4.5 feet. Above 4.5 feet the rating curve is based on two measurements.

Daily discharge, in second-feet, of Knife River at Broncho, N. Dak., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	710	330	39	14	4	4	3	5.5	16	670	65	52	9	3	3	5	5.5
2	1,050	290	39	12	4	4	3	5.5	17	490	65	52	9	3	3	5	5.5
3	1,700	231	39	12	4	4	3	5.5	18	310	65	26	5	3	3	5	5.5
4	2,800	164	65	12	4	3	3	5.5	19	196	65	26	5	4	3	5	5.5
5	3,500	164	65	6	4	3	3	5.5	20	134	65	26	5	4	3	5.5	5.5
6	2,900	164	350	6	4	3	3	5.5	21	134	58	26	5	4	3	5.5	5.5
7	2,600	134	231	6	4	3	3	5.5	22	120	52	26	5	4	3	5.5	5.5
8	2,200	120	310	6	4	3	3	5.5	23	106	45	26	5	4	3	5.5	5.5
9	2,030	106	120	6	4	3	3	5.5	24	134	39	26	5	4	3	5.5	5.5
10	1,620	92	213	26	4	3	3	5.5	25	164	39	26	5	4	3	5.5	5.5
11	1,680	78	164	39	4	3	3	5.5	26	164	39	26	5	3	3	5.5	5.5
12	1,620	78	39	26	4	3	4	5.5	27	164	39	26	5	3	3	5.5	.....
13	1,500	65	4	26	4	3	4	5.5	28	180	39	26	5	3	3	5.5	.....
14	1,040	65	2	20	3	3	5	5.5	29	196	39	26	5	3	3	5.5	.....
15	830	65	65	14	3	3	5	5.5	30	196	39	26	5	3	3	5.5	.....
									31	....	39	.....	5	3	.....	5.5	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Knife River at Broncho, N. Dak., for 1904–1908.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1904.							
April	3,500	106	1,040	0.825	0.92	61,900	
May	330	39	94.8	.075	.09	5,830	
June	350	2	72.9	.058	.06	4,340	
July	39	5	10.3	.0082	.009	633	
August	4.0	3.0	3.65	.0029	.003	224	
September	4.0	3.0	3.10	.0025	.003	184	
October	5.5	3.0	4.42	.0035	.004	272	
November	5.5	5.5	5.50	.0044	.005	327	
The period						73,700	
1905.							
March 23–31	25	14	18.3	.015	.005	327	A.
April	14	4	7.40	.0059	.007	440	B.
May	25	4	10.4	.0083	.01	640	A.
June	597	4	81.4	.065	.07	4,840	A.
July	555	4	58.3	.046	.05	3,580	A.
August	283	1	15.8	.013	.01	972	B.
September	4	0	1.42	.0011	.001	84.5	D.
October	5.5	2	2.40	.0019	.002	148	D.
November 1–26	7.0	2	4.08	.0032	.003	210	D.
The period						11,200	
1906.							
April	1,100	8.5	116	.092	.10	6,900	A.
May	2,410	5.5	397	.315	.36	24,400	B.
June	2,420	44	748	.594	.66	44,500	B.
July	1,700	16	103	.082	.09	6,330	A.
August	36	16	24.6	.020	.02	1,510	B.
September	22	10	14.4	.011	.01	857	B.
October	10	7.0	9.71	.0077	.009	597	C.
November 1–16	10	10.0	10.0	.0079	.005	317	C.
The period						85,400	
1907.							
April	373	32	98.7	.078	.09	5,870	B.
May	32	19	24.6	.020	.02	1,510	B.
June	266	19	38.2	.030	.03	2,270	B.
July	40	4	12.1	.0096	.011	744	B.
August	40	4	8.29	.0066	.008	510	C.
September	10	2	3.86	.0031	.003	230	C.
October	7	2	4.32	.0034	.004	266	C.
November	7	7	7.0	.0056	.006	417	C.
December 1–14	10	7	7.1	.0056	.003	197	C.
The period						12,000	
1908.							
March 12–31	663	108	293	.233	.17	11,600	A.
April	586	19	102	.081	.09	6,070	A.
May	597	10	114	.090	.10	7,010	A.
June	902	19	156	.124	.14	9,280	A.
July	19	4	9.67	.0077	.009	595	B.
August	7	4	4.58	.0036	.004	282	C.
September	4	0	2.37	.0019	.002	141	C.
October	14	4	5.52	.0044	.005	339	C.
November 1–21	7	4	5.43	.0043	.003	226	C.
The period						35,500	

NOTE.—The monthly estimates of flow for 1904 are only approximate. Monthly estimates for 1905–1908 are subject to some error due to the changing conditions at this station.

HEART RIVER DRAINAGE BASIN.

DESCRIPTION.

Heart River rises in eastern Billings County, N. Dak., flows eastward and southeastward for about 100 miles by general course, then turns abruptly to the north and northeast for 30 miles and enters Missouri River at Mandan, N. Dak. The entire drainage area is 3,350 square miles.

The largest tributaries are Big Muddy Creek, which enters from the north a few miles above the big bend and drains 480 square miles, and Green River, which is one of the headwaters and drains 340 square miles.

Altitudes range from 1,640 feet above sea level at Mandan to about 2,700 feet at the western boundary of the basin. The mean annual rainfall is from 13 to 17 inches, of which about half falls in the three months of May, June, and July. There is no forestation, merely scattering fringes and groves along the streams.

In this basin one station has been maintained:

Heart River near Richardton, N. Dak., 1903 to 1908.

HEART RIVER NEAR RICHARDTON, N. DAK.

This station, which is located at the steel highway bridge 10 miles south of Richardton, N. Dak., in or near sec. 21, T. 138, R. 92, and half a mile below the mouth of Blacktail Creek, was established May 18, 1903, to obtain data as to irrigation possibilities. The drainage area above this point is 1,250 square miles.

The datum of the gage has been unchanged, but the channel bottom is not permanent and occasional small changes in the rating curve are required. No extreme high stage measurements have yet been obtained, and not enough medium high stage measurements to properly define the upper portion of the rating curve; hence the estimates of the extreme floods are only approximate.

Discharge measurements of Heart River near Richardton, N. Dak., in 1906–1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 11	E. F. Chandler	64	61	5.05	38.4
August 29 [a]	do	18	12	4.50	18.2
1907.					
May 29	T. R. Atkinson	33	21.3	4.83	48.3
July 28	Atkinson and Chandler	58	163	5.04	48.7
Do [a]	do	25	27	5.03	53
1908.					
May 7	P. N. Ford	24	14.4	4.50	17.6
May 29	do	58	199	6.24	177
August 11 [a]	E. F. Chandler	11	2.6	4.10	1.8

[a] Made by wading.

Daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1907 and 1908.

[W. F. Church, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.										
1			6.4	4.5	4.5	4.5	4.6	4.2	4.2	4.2
2			6.1	4.5	4.5	4.4	4.5	4.2	4.2	4.2
3			5.9	4.5	4.4	4.4	4.5	4.2	4.2	4.2
4			5.8	4.5	4.4	4.3	4.5	4.1	4.2	4.2
5			5.7	4.5	4.4	4.2	4.5	4.1	4.2	4.2
6			5.7	4.5	4.4	4.1	4.4	4.1	4.2	4.2
7			5.6	4.5	4.5	4.1	4.4	4.1	4.2	4.2
8			5.6	4.5	4.5	4.1	4.4	4.1	4.2	4.2
9			5.6	4.5	4.5	4.4	4.4	4.1	4.2	4.2
10			5.5	4.5	4.4	4.2	4.4	4.0	4.2	.....
11			5.5	4.5	4.4	4.3	4.4	4.0	4.2	.....
12			5.4	4.5	4.4	4.2	4.4	4.0	4.2	.....
13			5.4	4.4	4.4	6.6	4.4	4.0	4.2	.....
14			5.3	4.4	4.4	6.0	4.3	4.0	4.2	.....
15			5.3	4.4	4.4	5.8	4.3	4.0	4.2	.....
16	5.2		5.3	4.4	4.4	5.6	4.2	4.0	4.2	.....
17	6.7		5.3	4.4	4.4	5.4	4.2	4.0	4.2	.....
18	8.1	6.9	5.2	4.4	4.4	5.3	4.2	4.0	4.2	.....
19	7.7	7.6	5.2	4.4	4.4	5.1	4.1	4.0	4.2	.....
20	7.4	10.1	5.2	4.4	4.4	6.8	4.1	4.3	4.2	.....
21	7.1	13.4	5.1	4.4	4.4	8.1	4.1	4.3	4.2	.....
22	6.3	14.2	5.0	4.4	4.4	6.6	4.1	4.3	4.2	.....
23	6.7	12.5	4.9	4.4	4.4	8.6	4.1	4.2	4.2	.....
24	6.7	11.3	4.8	4.4	4.4	7.9	4.8	4.2	4.2	
25		10.9	4.8	4.4	4.6	7.8	4.4	4.2	4.2	.....
26		10.8	4.7	4.6	6.1	7.6	4.3	4.1	4.2	.....
27		9.7	4.6	4.8	5.0	7.2	4.3	4.1	4.2	.....
28		9.3	4.6	4.8	4.8	6.4	4.3	4.1	4.2	.....
29		8.2	4.6	4.8	4.7	4.9	4.3	4.1	4.2	.....
30		7.7	4.6	4.7	4.6	4.8	4.2	4.1	4.3	.....
31		6.9	.....	4.6	.....	4.7	4.2	.....	4.3	.....
1908.										
1			5.5	4.8	5.5	4.6	4.6	4.1	4.2	4.6
2			5.5	4.7	5.4	4.5	4.5	4.1	4.2	4.6
3			5.5	4.6	5.5	4.5	4.5	4.1	4.2	4.5
4			5.5	4.6	5.7	4.5	4.4	4.0	4.2	4.5
5			5.5	4.5	7.6	4.4	4.3	4.0	4.3	4.4
6			5.5	4.5	6.8	4.4	4.3	4.0	4.3	4.4
7			5.5	4.5	7.0	4.4	4.2	4.0	4.2	4.3
8			6.0	4.5	6.7	4.3	4.2	4.0	4.2	4.3
9			6.5	4.5	6.0	4.3	4.2	3.9	4.2	.....
10			6.3	4.4	5.6	4.3	4.2	3.9	4.2	.....
11		4.9	6.0	4.4	5.3	4.3	4.2	3.9	4.2	.....
12		5.7	6.0	4.4	5.2	4.3	4.1	3.9	4.2	.....
13		5.4	5.9	4.4	6.0	4.3	4.1	3.9	4.2	.....
14		5.3	5.8	4.4	6.0	4.3	4.1	3.9	4.2	.....
15		7.0	5.7	4.5	5.9	4.3	4.1	3.9	4.2	.....
16		7.8	5.6	4.5	5.7	4.3	4.1	3.9	4.2	4.2
17		8.0	5.5	4.5	5.4	4.3	4.1	3.9	4.2	4.2
18		7.9	5.1	4.4	5.2	4.3	4.1	3.9	4.2	4.2
19		7.3	4.9	4.4	5.1	4.3	4.1	3.9	4.3	4.2
20		7.2	4.8	4.7	5.0	4.4	4.1	3.9	4.4	4.2
21		7.1	4.7	4.8	4.9	4.4	4.1	3.9	4.6	4.2
22		6.8	4.7	4.9	4.9	4.5	4.0	3.9	4.8	4.3
23		6.5	4.7	9.0	4.8	4.6	4.0	3.9	5.1	4.3
24		6.1	4.6	10.5	4.8	4.7	4.0	3.9	5.9	4.4
25		6.0	4.6	9.9	4.8	4.7	4.0	4.1	5.7	4.4
26		5.9	4.6	8.3	4.8	4.6	4.0	4.2	5.4	4.4
27		5.8	4.7	7.5	4.8	4.5	4.0	4.2	5.1	4.4
28		5.7	4.9	6.2	4.7	4.5	4.0	4.2	4.9	.....
29		5.6	4.9	6.0	4.7	4.4	4.0	4.2	4.8	.....
30		5.5	4.8	5.8	4.7	5.0	4.0	4.2	4.7	.....
31		5.5	.....	5.6	.....	4.8	4.0	.....	4.6	.....

NOTE.—Ice conditions January to March, 1907, and November 10, 1907, to March 18, 1908; November 9–20, November 28 to December 31, 1908. Water over the ice on February 16–24, 1907.

Rating table for Heart River near Richardton, N. Dak., for 1906–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.90	0.3	5.50	98	7.20	365	12.00	1,570
4.00	1	5.60	111	7.40	403	13.00	1,920
4.10	2	5.70	124	7.60	442	14.00	2,270
4.20	4	5.80	138	7.80	482	15.00	2,670
4.30	7	5.90	152	8.00	523	16.00	3,070
4.40	11	6.00	167	8.20	565	17.00	3,470
4.50	16	6.10	182	8.40	607	18.00	3,920
4.60	21	6.20	197	8.60	651	19.00	4,370
4.70	27	6.30	212	8.80	695	20.00	4,870
4.80	33	6.40	228	9.00	741	21.00	5,370
4.90	40	6.50	244	9.20	788	22.00	5,870
5.00	48	6.60	260	9.40	836	23.00	6,420
5.10	56	6.70	277	9.60	885	24.00	6,970
5.20	65	6.80	294	9.80	935	25.00	7,520
5.30	75	6.90	311	10.00	990	26.00	8,070
5.40	86	7.00	329	11.00	1,270		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906–1908, and is fairly well defined between gage heights 4.0 feet and 8.0 feet. Above gage height 8.0 feet it is based on one measurement at gage height 11.10 feet and is only roughly approximate.

Monthly discharge of Heart River near Richardton, N. Dak., for 1906–1908.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1906.							
March 26–31	812	311	503	0.402	0.09	5,990	B.
April	695	11	100	.080	.09	5,950	B.
May	1,830	11	276	.221	.25	17,000	B.
June	8,020	27	1,090	.872	.97	64,900	B.
July	33	11	24.0	.019	.02	1,480	B.
August	33	11	19.2	.015	.02	1,180	B.
September	16	4	8.0	.0064	.007	476	C.
October	7	4	4.3	.0034	.004	264	C.
November 1–16	11	7	8.0	.0064	.004	254	C.
The period						97,500	
1907.							
March 18–31	2,350	311	1,060	.848	.44	29,400	D.
April	228	21	82.2	.066	.07	4,890	C.
May	33	11	16.2	.013	.02	996	D.
June	182	11	20.7	.017	.02	1,230	D.
July	651	2	156	.125	.14	9,590	C.
August	33	2	9.3	.0074	.009	573	D.
September	7	1	2.6	.0021	.002	153	D.
October	7	4	4.2	.0034	.004	258	D.
November 1–9	4	4	4.0	.0032	.001	71.4	D.
The period						47,200	
1908.							
March 19–31	384	98	208	.166	.08	5,360	B.
April	244	21	94.2	.075	.08	5,610	B.
May	1,120	11	156	.125	.14	9,590	B.
June	442	27	112	.090	.10	6,660	B.
July	48	7	14.3	.011	.01	879	B.
August	21	1	4.1	.0033	.004	252	C.
September	4	0.3	1.26	.0010	.001	75	D.
October	152	4	24.0	.019	.02	1,480	B.
November 1–27	21	4	8.5	.0068	.007	455	C.
The period						30,400	

CANNON BALL RIVER DRAINAGE BASIN.

DESCRIPTION.

Cannon Ball River is formed by the junction of its north and south branches (the South Branch being also known as Cedar River), which rise in the southwestern part of North Dakota and flow eastward and southeastward nearly parallel with each other for a distance of 100 miles in a direct line before joining. The drainage area of each branch is 1,700 square miles or a little more. Below the junction the stream flows northeastward 45 miles to Missouri River, which it enters 35 miles north of the South Dakota line. The total drainage area is about 4,200 square miles.

The only important tributaries are Dogtooth Creek, which enters 20 miles above the mouth of the river and drains 340 square miles, and Thirtymile Creek, which enters the North Branch 40 miles above the junction of the branches and drains 250 square miles.

The only trees grown in the Cannon Ball basin are the fringes of the streams and the occasional very small groves in the bottom land. Altitudes range from 1,600 feet at the mouth to 3,000 feet, with a few hills at the western margin rising to 3,500 feet. The mean annual rainfall varies from 12 to 17 inches in different parts of the area.

The basin contains many reservoir sites, some with capacities of 20,000 acre-feet or more. Large tracts of land in the valley might be advantageously irrigated by stored water if routes can be found for diversion canals that will not be unduly expensive, but the topography of the valley does not as a rule favor the construction of long canals, and the fall of the main river through most of its length is only from 3 to 6 feet to the mile.

One station has been maintained in this basin:

Cannon Ball River at Stevenson, N. Dak., 1903 to 1908.

CANNON BALL RIVER AT STEVENSON, N. DAK.

This station, which is located one-half mile west-northwest of the post-office at Stevenson, N. Dak., in sec. 20, T. 133, R. 82, about 40 miles south of Mandan, N. Dak., was established June 10, 1903, to determine the availability of the stream for irrigation. The station is 25 miles above the mouth of the river and 4 miles above the mouth of Dogtooth Creek. The drainage area at this point is 3,650 square miles.

The channel is of gravel and small stones and is permanent, and no appreciable changes in the rating curve from year to year are necessary. An excellent rating table has been deduced.

On account of the nature of the banks and the destruction caused by ice in the spring freshets, it is difficult to keep a gage fixed immov-

ably and satisfactorily permanent, although it can be precisely replaced as often as necessary. Hence, systematic errors as great as 0.1 foot, or even slightly more, may sometimes have entered the daily gage record for several weeks without discovery. In 1908, owing to an unnoticed accident to the gage, the records were not accurate from the opening of the season until August 1. It seems probable that they were continuously somewhat too large for that period.

Except as thus specified, the records are satisfactory and reliable.

Discharge measurements of Cannon Ball River at Stevenson, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 22[a]	T. R. Atkinson	39	47.2	3.46	84
June 1[a]	do	38	42.7	3.16	78
July 23	Chandler and Hoskins	109	310	4.62	532
Do	E. F. Chandler	110	338	4.77	631
July 24	do	109	291	4.47	467
Do	do	109	287	4.33	416
July 25	do	108	267	4.16	335
July 30	Follansbee and Chandler	106	194	3.55	128
Do.[a]	do	42	67	3.54	129
1908.					
August 5[a]	E. F. Chandler	38	32.4	2.73	8.6
August 6[a]	do	38	31.6	2.71	9.0

[a] Made by wading.

Daily gage height, in feet, of Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908.

[Donald Stevenson, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1			5.7	3.3	3.2	3.4	2.9		2.3	2.2	
2			5.1	3.1	3.2	3.5	2.8	2.0	2.3	2.3	
3			5.2	3.2	3.4	3.5	2.8	2.0	2.3	2.4	
4			4.9	3.2	3.4	3.4	2.2	1.7	2.4	2.5	
5			4.9	3.4	5.7	3.3	2.3	1.7	2.4	2.4	
6			4.8	3.3	7.4	3.3	2.1	1.6	2.1	2.4	
7			4.7	3.4	8.2	3.3	2.1	1.6	1.9	2.2	
8			4.6	3.5	8.4	3.8	2.1	2.1	2.1	2.3	
9			4.5	3.6	3.2	3.6	2.3	2.1	2.1	2.3	
10			4.3	3.4	3.1	3.6	2.4	2.0	2.1		
11			3.6	3.5	3.4	3.7	3.2	1.9	2.2		
12			3.4	3.1	5.6	3.5	3.2	1.9	2.1		
13			3.6	3.2	6.2	3.5	3.2	1.8			
14			3.4	3.0	5.7	3.5	3.1	1.8			
15			3.5	3.0	5.0	4.5	3.0	1.6			
16			3.2	2.9		4.5	3.0	1.8			
17	7.1		3.3	3.2		3.7	3.0	2.0		2.2	
18	9.5		3.2	3.1		3.3	2.7	2.0		2.3	
19	9.7		3.2	3.5		3.5	2.7	2.3		2.9	
20	9.8		3.1	3.4		3.7	2.5	2.3		2.7	
21	9.7		3.3	3.7		5.4	2.5	2.4		2.7	
22	9.0		3.2	3.8		5.6	2.4	1.9		2.6	
23	5.0		3.2	4.1	3.6	4.9	2.5	1.9		2.5	
24		7.2	3.2	4.6	3.7	4.7	2.3	1.8		2.0	
25		6.4	3.3	4.9	3.7	4.2	2.3	1.8		2.1	
26		5.2	3.1	3.2	3.7	4.0	2.3	1.9	1.7	2.2	
27		6.4	3.3	3.4	3.6	3.9	2.3	1.9		2.1	
28		6.5	3.0	3.3	3.6	4.9	2.2	1.7		2.1	
29		6.2	3.1	3.5	3.6	3.5	2.2	2.4		2.1	
30		4.7	3.1	3.2		3.2	2.1	2.4		2.1	
31		4.6		3.3		3.1	2.1		2.1		

Daily gage height, in feet, of Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	.....	3.5	4.0	5.4	4.0	2.7	2.3	2.5	2.1	.....
2	.....	3.5	4.0	7.2	4.0	2.7	2.4	2.8	2.1	.....
3	.....	3.5	4.0	7.5	3.5	2.8	2.4	2.0	2.0	.....
4	.....	3.5	3.8	7.3	3.0	2.7	2.5	2.0	2.0	.....
5	.....	3.5	3.8	7.0	3.0	2.7	2.3	2.0	2.0	.....
6	.....	3.5	3.8	6.8	2.8	2.7	2.5	2.0	2.0	3.1
7	.....	3.5	3.5	6.5	2.5	2.7	2.5	2.1	2.0	.....
8	3.3	3.5	3.5	7.3	2.4	3.0	2.45	2.1	2.1	.....
9	4.5	3.5	3.5	7.0	3.0	2.8	2.4	2.1	2.1	.....
10	8.0	3.5	3.5	7.0	4.5	2.5	2.4	2.1	2.0	.....
11	6.0	3.5	3.5	6.5	4.8	2.4	2.4	2.0	2.0	3.1
12	6.0	3.6	3.5	7.0	4.2	2.4	2.3	2.0	2.0	.....
13	5.5	3.6	3.5	7.5	4.0	2.2	2.0	2.1	2.0	3.5
14	5.0	3.7	4.2	6.5	3.9	2.2	2.0	2.1	2.0	.....
15	4.5	3.8	4.9	6.0	3.5	2.4	2.0	2.1	.....	.....
16	5.0	3.8	4.5	5.5	3.4	2.5	2.0	2.1	.....	.....
17	6.5	3.9	5.5	5.3	4.0	2.4	2.1	2.1	.....	.....
18	7.0	4.0	5.7	5.0	4.5	2.5	2.1	3.0	.....	.....
19	8.0	4.7	5.6	4.7	4.0	2.5	2.1	4.1	.....	.....
20	9.0	4.7	5.6	4.5	3.7	2.4	2.1	4.2	.....	2.5
21	7.5	4.7	5.0	4.2	3.5	2.4	2.0	4.25	.....	.....
22	4.5	4.2	4.9	4.0	3.2	2.3	2.0	3.2	2.5	.....
23	4.5	4.5	4.9	3.5	3.0	2.3	2.0	3.0	2.5	.....
24	4.3	5.0	4.6	3.5	3.0	2.3	2.1	2.6	2.5	.....
25	4.0	5.5	4.6	3.2	2.5	2.3	2.2	3.1	2.6	.....
26	4.0	5.4	4.6	3.0	2.5	2.3	2.2	2.5	3.0	.....
27	3.9	5.2	4.4	3.0	2.4	2.0	2.1	2.8	3.0	.....
28	3.7	5.0	4.9	3.0	2.5	2.0	2.3	2.2	.....	.....
29	3.5	4.8	5.5	3.0	2.5	2.2	2.5	2.3	3.0	.....
30	3.5	4.5	6.6	3.5	2.7	2.2	2.5	2.1	.....	.....
31	3.7	.....	6.2	.....	2.7	2.25	.....	2.0	.....	.....

NOTE.—Ice conditions, January 1 to March 23, 1907; December 1, 1907, to March 10, 1908; November 12 to December 31, 1908. Water running over ice and ice gorging, February 17–22, 1907; light ice, November 17, 1907. March 8 to July 31, 1908, the gage was in poor condition and the gage heights are only approximate.

Rating table for Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	0.0	3.20	58	4.40	438	6.20	1,570
2.10	.5	3.30	74	4.50	485	6.40	1,730
2.20	1.1	3.40	93	4.60	534	6.60	1,890
2.30	2	3.50	115	4.70	585	6.80	2,050
2.40	3	3.60	140	4.80	638	7.00	2,210
2.50	4	3.70	168	4.90	693	7.20	2,384
2.60	5	3.80	199	5.00	750	7.40	2,558
2.70	9	3.90	233	5.20	868	7.60	2,732
2.80	16	4.00	270	5.40	994	7.80	2,906
2.90	24	4.10	309	5.60	1,127	8.00	3,080
3.00	33	4.20	350	5.80	1,265	9.00	4,000
3.10	44	4.30	393	6.00	1,410		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1903–1908, and is well defined between gage heights 2.5 feet and 5.0 feet. Above gage height 5.0 feet it is based on one high-water measurement at gage height 7.18 feet and is only approximate.

Monthly discharge of Cannon Ball River near Stevenson, N. Dak., for 1907 and 1908.

[Drainage area, 3,650 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 24–31	2,380	534	1,380	0.378	0.11	21,900	A.
April	1,200	33	264	.072	.08	15,700	A.
May	693	24	124	.034	.04	7,620	A.
June	3,450	44	655	.180	.20	39,000	A.
July	1,130	44	261	.072	.08	16,000	A.
August	58	.....	13.7	.0038	.004	842	B.
September	3.0	.....	.47	.00013	.0001	28.0	D.
October	3.0	.....	.52	.00014	.0002	32.0	D.
November	24	.....	3.0	.00082	.0009	179	D.
The period	.....	.....	.....	.....	.....	101,000	
1908.							
March 11–31	4,000	115	1,060	.291	.23	44,100	B.
April	1,060	115	358	.098	.11	21,300	B.
May	1,890	115	569	.156	.18	35,000	B.
June	2,640	33	1,210	.332	.37	72,000	B.
July	638	3	143	.039	.04	8,790	B.
August	33	0	5.45	.0015	.002	335	C.
September	4	0	1.72	.00047	.0005	102	D.
October	372	0	40.4	.011	.01	2,480	D.
The period	.....	.....	.....	.....	.....	184,000	

NOTE.—Discharge estimated for days when gage heights are missing.

GRAND RIVER DRAINAGE BASIN.

NORTH FORK OF GRAND RIVER AT HALEY, N. DAK.

The North Fork of Grand River unites with the South Fork to form the Grand in the northeastern part of Butte County, S. Dak., the main stream flowing from this junction eastward across the Standing Rock Indian Reservation to the Missouri.

This station, which is located about 20 rods south of the post-office at Haley, N. Dak., near the northeast corner of sec. 36, T. 129, R. 100, was established May 17, 1908, to obtain data for the reclamation project under survey at that point. The drainage area above the station includes only the North Fork of the Grand and comprises about 500 square miles. As no measurements at high stage have yet been made, no rating curve has been prepared.

Discharge measurements of North Fork of Grand River at Haley, N. Dak., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11[a]	P. N. Ford	9	1.9	0.95	1.8
August 18[a]	E. F. Chandler	1.0	.19	.86	.15

[a] Made by wading.

Daily gage height, in feet, of North Fork of Grand River at Haley, N. Dak., for 1908.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.7	1.65	1.1	0.9	0.9	0.9	0.9
2	.....	2.0	1.3	.....	.9	.9	.9	.9
3	.....	2.5	1.1	.....	.9	.9	.9	.9
4	.....	2.8	1.1	.....	.9	.9	.9	.9
5	.....	1.8	1.0	.....	.9	.9	.9	.9
6	.....	1.2	1.4	.....	.9	.9	.9	.9
7	.....	1.8	1.3	.....	.9	.9	.9	.9
8	.....	1.7	1.3	.....	.9	.9	.9	.9
9	.....	1.65	1.6	.8	.9	.9	.9	.9
10	.....	1.5	1.3	.....	.9	.9	.9	.9
11	.....	1.4	1.0	.....	.9	.9	.9	.9
12	.....	1.45	.9	.....	.9	.9	.9	.9
13	.....	1.3	.9	.....	.9	.9	.9	.9
14	.....	2.8	.9	.....	.9	.9	.9	.9
15	.....	4.7	.9	.....	.9	.9	.9	.9
16	.....	3.0	.9	.85	.9	.9	.9	.9
17	1.0	3.0	.85	.85	.9	.9	.9	.9
18	1.0	2.05	.....	.85	.9	.9	.9	.9
19	1.0	1.2	1.1	.85	.9	1.0	.9	.9
20	3.8	1.9	1.1	.85	.9	1.0	.9	.9
21	4.8	1.4	1.1	.85	.9	1.0	.9	.9
22	5.5	1.8	1.1	.85	.9	.9	.9	.9
23	5.6	1.3	1.1	.85	.9	.9	.9	.9
24	3.8	1.1	1.1	.85	.9	.9	.9	.9
25	3.8	1.2	1.1	.85	.9	.9	.9	.9
26	3.2	1.4	1.1	.85	.9	.9	.9	.9
27	2.75	1.9	1.1	.85	.9	.9	.9	.9
28	2.0	1.4	1.1	.9	.9	.9	.9	.9
29	1.8	1.0	1.1	.9	.9	.9	.9	.9
30	1.8	1.7	1.1	.9	.9	.9	.9	.9
31	1.8	.....	1.1	.9	.....	.9	.....	.9

NOTE.—Ice conditions November 5 to December 31.

NIOBRARA RIVER DRAINAGE BASIN.

DESCRIPTION.

Niobrara River rises in the mountains of eastern Wyoming, flows eastward through the northern portion of Nebraska, and empties into the Missouri in Knox County at the city of Niobrara. Its drainage basin is narrow in the upper portion but broadens considerably near the mouth; it comprises about 9,000 square miles.

Precipitation within the basin varies from 15 to 18 inches in the upper portion, from 18 to 21 inches in the middle portion, and from 21 to 24 inches in the lower portion. Evaporation is 6, 5, and 4½ feet in the upper, middle, and lower portions, respectively. Sixty-nine per cent of the precipitation falls during April, May, June, July, and August, and about one-half of the remainder is snowfall.

The river is not subject to periodic rises of any importance, owing to the fact that the sand hills which form so large a portion of its drainage area act as storage reservoirs for the rain and snow, which are afterwards fed to the stream in the form of spring water, thus equalizing the flow and making the constancy of the discharge almost phenomenal.

The principal tributaries are Verdigris, Keyapaha, and Snake rivers, and Minnechaduza Creek. The drainage area of the Snake is similar in nearly all respects to that of the western part of the Niobrara.

The water resources of the Niobrara are at present almost wholly undeveloped, irrigation being limited to the low, narrow flood plains in the bottoms of the canyons. On Minnechaduza Creek at Valentine an artificial lake has been formed by a dam, and a power plant has been installed for lighting and for furnishing the city with water. On the lower course of the Niobrara a number of mills are in operation, receiving their power from small tributaries. On Snake River opportunities for power development are phenomenal, but long transmission lines would be required to make it of practical value.

The following gaging stations have been maintained in this basin:

Niobrara River near Valentine (Fort Niobrara), Nebr., 1897, 1899, 1901–1906.
Niobrara River near Spencer, Nebr., 1908.
Niobrara River near Niobrara, Nebr., 1902.
Red Deer Lake near Woodlake, Nebr., 1904–5.

NIOBRARA RIVER NEAR SPENCER, NEBR.

This station, which was established May 15, 1908, and discontinued December 31, 1908, is located at the Whiting highway bridge, 6½ miles south of Spencer, in sec. 30, T. 33 N., R. 11 W.

The records at this point show practically the entire flow of the river, Verdigris River being the only important tributary below. Keyapaha River enters 20 miles above.

A few ditches taking water for irrigation for the low, narrow flood plain constitute the only diversion from the river. Ice probably does not affect results materially. Measurements are difficult on account of the high velocity of the current. The bed is composed partly of shifting sand, and frequent measurements are necessary to obtain good results. Sufficient data have not been obtained to form a basis for computations of discharge.

Discharge measurements of Niobrara River near Spencer, Nebr., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	G. W. Bates	117	409	4.80	2,830
May 16	do	120	400	4.70	2,830
June 11	Arthur Dobson	138	389	4.55	2,590
July 23	do	150	334	4.60	1,280
September 9	do	150	189	4.62	867

Daily gage height, in feet, of Niobrara River near Spencer, Nebr., for 1908.

[A. J. Lamb, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.6	4.4	4.5	4.3	4.6	4.6	5.1
2		4.5	4.5	4.4	4.7	4.5	4.5	4.8
3		4.5	4.4	4.5	4.6	4.7	4.7	4.9
4		4.4	4.3	4.6	4.4	4.5	4.8	5.1
5		4.8	4.3	4.7	4.7	4.7	4.8	5.0
6		4.6	4.3	4.6	4.5	4.9	4.8	5.5
7		5.0	4.2	4.4	4.9	4.8	4.7	5.1
8		4.5	4.3	4.3	4.7	4.6	4.8	5.2
9		4.8	4.4	4.6	4.6	4.6	4.7	5.1
10		4.5	4.5	4.7	5.0	4.7	4.8	5.2
11		4.5	4.4	5.0	5.0	4.6	4.7	5.3
12		4.9	4.3	4.6	4.8	4.6	4.8	5.1
13		6.0	4.4	4.4	4.7	4.7	5.0	5.0
14		4.4	4.3	4.3	4.8	4.6	5.1	5.0
15	4.8	4.5	4.4	4.6	5.0	4.6	5.0	5.2
16	4.5	4.6	4.6	4.6	5.0	4.7	4.8	5.0
17	4.7	4.6	4.6	4.8	5.0	4.6	5.0	4.7
18	4.6	5.5	4.7	4.5	4.8	4.6	5.8	4.7
19	4.7	4.8	4.5	4.6	4.9	4.7	5.4	4.8
20	4.5	4.2	4.5	4.5	5.0	5.4	4.9	4.7
21	4.6	4.1	4.8	4.3	5.0	5.2	4.8	4.8
22	4.5	4.7	4.6	4.5	5.0	5.0	4.8	5.0
23	4.6	5.9	4.6	4.3	5.0	4.7	4.9	4.8
24	4.3	4.5	4.8	4.6	4.8	4.6	4.9	4.9
25	4.7	4.4	4.7	4.6	4.8	4.7	4.9	5.0
26	4.4	4.4	5.0	7.0	6.0	4.8	5.3	5.0
27	4.8	4.2	4.6	5.0	4.5	4.7	5.0	5.2
28	4.5	4.4	4.5	4.7	4.4	4.6	5.3	5.0
29	4.6	4.4	4.4	4.6	4.5	4.5	5.2	4.9
30	4.6	4.4	4.5	4.8	4.7	4.7	5.6	4.7
31	4.5		4.5	4.6		4.8		4.8

NOTE.—Possible ice conditions during December.

PLATTE RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Considered only with regard to extent of the area drained, the Platte is the most important tributary of the Missouri. It is formed by two forks, North Platte and South Platte, which rise, respectively, in northern and in central Colorado and unite a little southwest of the center of Nebraska. Its entire drainage basin comprises about 84,000 square miles, of which 28,500 square miles belong to the North Platte and 24,000 to the South Platte. The lower course of the river is fairly well settled, but farther west the population is more scattered.

For convenience the description of the basin is divided, and the North Platte, Platte River proper, and South Platte are considered separately, being arranged in downstream order.

NORTH PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

The source of North Platte River is in North Park, Colorado, or rather in the mountains which, rising to elevations from 4,000 to 5,000 feet above its general level, hem it in on all sides. The park is

just east of the Continental Divide, some of the peaks of which in that locality exceed 12,000 feet in altitude. From the steep slopes of the mountains numerous small streams descend, unite below into large creeks, and flow outward to the center of the basin. The two which may be said to form the real head of the North Platte are Grizzly and Little Grizzly creeks, but within the park the river is joined by four large tributaries, Roaring Fork and North Fork from the west and Michigan and Canadian creeks from the east. Leaving the park, the river makes a bold curve northward into Wyoming, but near Casper, on the north side of the Casper Range, it turns abruptly to the east and southeast, maintaining the latter course to its point of junction with the South Platte in central Nebraska.

Within North Park the topographic features are diversified, including every degree of roughness from the snow-capped peaks of the Park and Medicine Bow ranges to the level prairie mesas along the lower portion of the stream. Dense forests cover the mountain tracts, the heaviest being those on the east slope of the Park and the west slope of the Medicine Bow ranges. At an elevation of 8,500 feet above sea level the forests give way to the open prairie country, which, with the exception of the dense growth of willows along the river bottoms, is entirely free from forests of any description.

The soil, composed principally of sandy and gravelly loam on the mesas and of sandy and black loam along the river bottoms, is in general fertile, but climatic conditions are such that the agricultural products are limited to wild hay, roots, and a few of the hardier grains.

In its northward course through Wyoming the stream receives many tributaries, the Snowy Range on the east contributing its drainage through Douglas, French, and Brush creeks, while the northeast slope of the Sierra Madre is drained by Beaver, Big Cow, and Spring creeks and Grand Encampment River. Medicine Bow and Sweetwater rivers are added to the North Platte between Saratoga and Casper, beyond which the only important tributary is the Laramie, which enters at old Fort Laramie.

The greater part of the region below Saratoga is a rolling, undulating prairie. The soil throughout Wyoming is a sandy loam of sufficient depth to produce meadows of rich grasses, even up to elevations of 7,000 feet. At lower elevations the soil becomes more friable and deeper.

Throughout its course in western Nebraska the valley of the North Platte is 10 to 15 miles wide. The present floor, consisting of sediments deposited in a former greater valley, is bordered by terraces and table-lands scarred by numerous tributaries and arroyos. The stream is broad and shallow, with a flood plain from 1 mile to 4 miles wide.

A. PATHFINDER DAM SITE BEFORE CONSTRUCTION, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

B. PATHFINDER DAM, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

The character of the river bed at the Big Bend and at the Seminoe Mountains, in Wyoming, seems to indicate a considerable underflow. A part of this is collected at the Big Bend, and probably the entire amount is brought to the surface as the river passes through the Seminoe Range. In its lower course the bed of the stream is of fine quicksand underlain at a depth of 15 to 20 feet by a hard layer which seems to be clay.

The total length of the river from source to mouth is nearly 650 miles. At Pinkhampton, Colo., it is about 8,000 feet above sea level; at Fort Steele, Wyo., about 500 miles above its mouth, it is 6,500 feet; and at Fort Laramie it is 4,200 feet, and at North Platte, Nebr., 2,800 feet.

The drainage area includes about 28,800 square miles, of which 1,800 square miles are in Colorado, 20,000 in Wyoming, and nearly 7,000 in Nebraska.

In the mountain districts precipitation, usually in the form of snow during the winter and spring months, varies from 7 to 15 inches, the average being about 11 inches; in the high mountains it is 20 inches and upwards. Throughout the lower portion of the basin the precipitation is from 15 to 18 inches, and the evaporation from the water surface is 5 to 6 feet annually.

The stream is subject to periodic floods which reach the maximum at the mouth some time during the latter part of June and are caused by the melting snow on the high ranges. The river runs lowest in winter and is usually covered with thick ice. High water prevails from the middle of April until the middle of July, during which period the river is frequently bank full.

The winters are quite severe throughout the entire basin of this stream, and particularly so above an altitude of 4,000 feet. On the plains areas, although there is considerable snowfall, the snow does not lie for more than a few days at a time.

Agriculture in the basin of the North Platte has been confined largely to the valleys of the tributaries, and most of the available agricultural lands on these tributaries are now occupied. At present irrigation is most extensively practiced on Laramie and Little Laramie rivers in the vicinity of Laramie; on the Laramie in the vicinity of Wheatland, and on the North Platte itself for a considerable distance on both sides of the Wyoming-Nebraska line.

The Laramie-Poudre project will divert a considerable portion of the flow of Laramie River in Colorado across the divide by means of a tunnel into the headwaters of the Cache la Poudre, where the waters will be used to irrigate land in the South Platte drainage. Construction is about to be begun on this project. The nearly completed North Platte project of the Reclamation Service will provide for the

irrigation of about 100,000 acres of land along the North Platte in Nebraska and Wyoming. (Pl. XI, *A* and *B*.) Numerous other irrigation projects are contemplated or are in course of construction, and many additional opportunities for development by storage of flood waters still remain.

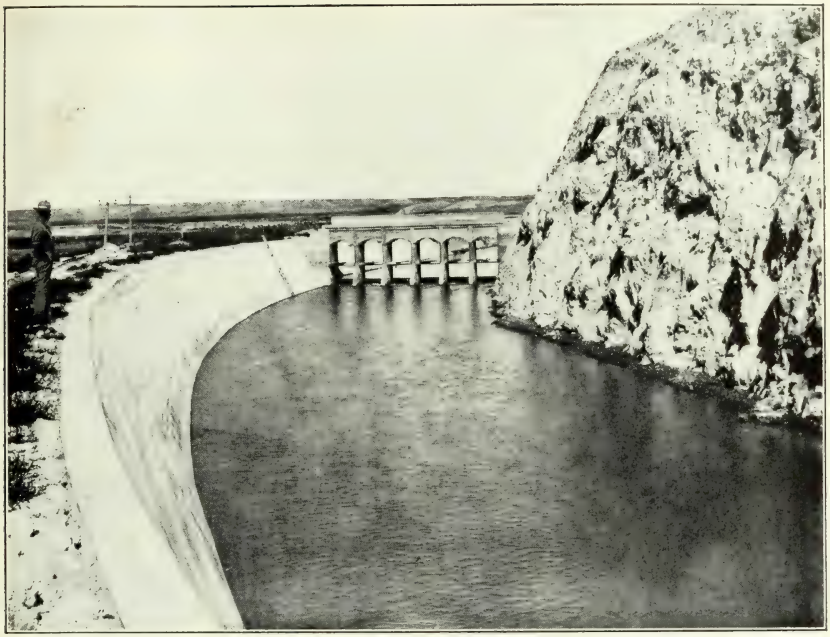
The basin contains many excellent reservoir sites, a few of which have been developed. The most notable is the Pathfinder reservoir of the United States Reclamation Service. This reservoir, with a dam 215 feet high, will have a capacity of over 1,000,000 acre-feet. (See Pl. X.) Another excellent site is at what is usually known as the "Devils Gate" on Sweetwater River a few miles above its mouth. It has a capacity of over 300,000 acre-feet, but has never been developed on account of the inadequacy of the water supply; and as the Pathfinder reservoir will store the flood waters of the Sweetwater it is not likely that the Devils Gate reservoir will ever be built. On the North Platte and its tributaries in Colorado are several fairly good reservoir sites, the largest being on the North Platte near Pinkhampton, which would have a capacity of nearly 100,000 acre-feet with a dam 100 feet high. The reservoir site on Laramie River near Glendevey, Colo., has a capacity of about 15,000 acre-feet.

Power development on the North Platte will be limited largely to the upper river and its tributaries and probably never will be in excess of 50,000 horsepower. Present development amounts to only a few hundred horsepower.

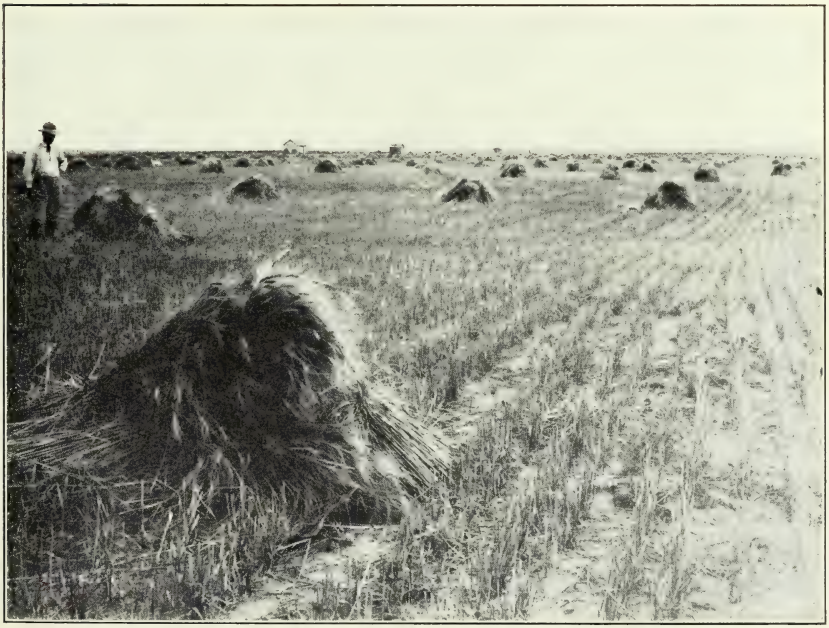
The more recent records of the United States Geological Survey indicate 1902 as the driest and 1907 as the wettest year, but it is believed that 1899 was a much higher year than 1907.

The following stations have been maintained in this basin:

Grizzly Creek at Hebron, Colo., 1904–5.
North Platte River near Hebron, Colo., 1904–5.
North Platte River near Cowdrey, Colo., 1904–5.
North Platte River near Pinkhampton, Colo., 1904.
North Platte River at Saratoga, Wyo., 1903–1906.
North Platte River at Pathfinder, Wyo., 1905–1908.
North Platte River at Alcova, Wyo., 1904–5.
North Platte River near Douglas, Wyo., 1894.
North Platte River near Orin Junction, Wyo., 1895–1900.
North Platte River near Fort Laramie, Wyo., 1887–1889.
North Platte River at Guernsey, Wyo., 1900–1908.
North Platte River near Mitchell, Nebr., 1901–1908.
North Platte River near Gering, Nebr., 1897–1900.
North Platte River near Camp Clark, Nebr., 1896–1900.
North Platte River at Bridgeport, Nebr., 1902–1906.
North Platte River at North Platte, Nebr., 1894–1908.
Little Grizzly Creek at Hebron, Colo., 1904–5.
Roaring Fork of North Platte near Hebron, Colo., 1904–5.
North Fork of North Platte at Higho, Colo., 1904–5.
Michigan Creek near Walden, Colo., 1904–5.



A. INTERSTATE CANAL WASTEWAY AT MOLLIES FORK, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.



B. GRAIN FIELD UNDER THE INTERSTATE CANAL, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

Michigan Creek near Cowdrey, Colo., 1904–5.
Canadian River at Cowdrey, Colo., 1904–5.
Grand Encampment Creek near Peryam's ranch, Wyo., 1900.
Medicine Bow River near Medicine Bow, Wyo., 1901.
Sweetwater River near Splitrock, Wyo., 1902–3.
Laramie River at Glendevey, Colo., 1904–5.
Laramie River near Jelm, Wyo., 1904–5.
Laramie River near Woods Landing, Wyo., 1895–1900.
Laramie River near Uva, Wyo., 1895–1900, 1903.
McIntyre Creek near Gleneyre, Colo., 1904–5.
Little Laramie River near Hatton, Wyo., 1902–3.
Little Laramie River near Laramie, Wyo., 1903.

NORTH PLATTE RIVER AT PATHFINDER, WYO.

This station, which is located one-half mile south of Pathfinder post-office and 500 feet below the mouth of the canyon, in sec. 24, T. 29 N., R. 84 W., sixth principal meridian, Wyoming, was established May 9, 1905, and has been maintained by the United States Reclamation Service to show the amount of water available for storage in connection with the North Platte project.

The Pathfinder dam site (Pl. X, A) is about one-fourth mile above the station, which is at an elevation of nearly 5,700 feet. Sweetwater River enters the North Platte about 3 miles above the station. The drainage area is about 12,000 square miles.

Very little water is diverted above the station. Some land is irrigated on the North Platte and its tributaries, but opportunities for much additional development can be found.

The datum of the gage has remained constant during the maintenance of the station. The flow is affected by ice for several months during the winter season. The results obtained at this station have been on the whole very satisfactory.

Discharge measurements of North Platte River at Pathfinder, Wyo., from 1905 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 26	L. V. Branch		507	0.88	189
October 3	do		640	1.57	426
Do	do		633	1.57	434
November 15	do		597	1.32	315
1906.					
February 8[a]	Branch and Sussex	79	381	1.80	199
February 22[a]	do	82	426	1.97	279
April 5	do	199	1,090	4.00	2,180
May 11	L. V. Branch	204	1,410	5.52	4,190
May 22	J. W. Sussex	209	1,840	7.40	8,180
June 22	Branch and Sussex	203	1,590	6.47	6,000
1907.					
May 23	L. V. Branch	230	1,980	8.25	9,930
June 18	do	249	2,160	8.92	11,400
1908.					
February 17[a]	L. V. Branch	171	515	[b]1.58	349

[a] Gaging made through ice.
[b] Gage height to water surface through hole in ice. Ice 18 inches thick.

Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1905, 1907, and 1908.[a]

[Charles E. Hamilton and William F. Costello, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1						6.95	5.42	2.40	1.00	1.20	1.55	1.30
2						7.18	5.05	2.45	1.00	1.65	1.50	1.40
3						7.45	4.85	2.72	1.00	1.65	1.38	1.35
4						7.78	5.10	2.62	1.00	1.40	1.25	1.45
5						8.70	5.02	2.50	.98	1.35	1.45	1.30
6						9.20	4.72	2.32	1.60	1.28	1.60	1.32
7						8.95	4.40	2.18	1.58	1.25	1.75	1.25
8						8.85	4.00	2.15	1.38	1.25	1.82	1.30
9						8.88	3.65	2.10	1.60	1.20	1.80	1.30
10					4.05	9.28	3.65	2.05	1.48	1.20	1.80	1.10
11					4.42	9.50	3.65	2.00	1.42	1.15	1.75	1.30
12					4.50	9.15	3.65	1.92	1.38	1.15	1.60	1.25
13					4.30	8.92	3.50	2.10	1.28	1.20	1.50	1.28
14					4.10	8.68	3.32	2.35	1.08	1.20	1.48	1.20
15					3.98	8.10	3.18	2.22	.88	1.20	1.45	1.25
16					3.90	8.22	3.10	2.05	1.00	1.30	1.50	1.28
17					3.82	8.12	3.00	2.00	1.00	1.40	1.55	1.25
18					3.95	8.12	2.92	1.95	1.00	1.40	1.58	1.20
19					4.48	7.75	2.85	1.80	.95	1.40	1.65	1.22
20					5.22	7.30	2.85	1.68	.90	1.40	1.65	1.22
21					6.02	6.95	2.95	1.48	.85	1.48	1.70	1.18
22					6.32	6.75	2.88	1.35	.85	1.35	1.60	1.22
23					6.70	6.68	2.80	1.30	.85	1.40	1.42	1.20
24					6.98	6.60	2.75	1.30	.90	1.38	1.30	1.15
25					7.28	6.75	2.68	1.25	.88	1.45	1.10	1.08
26					7.20	6.42	2.58	1.22	.88	1.50	1.10	1.15
27					7.25	6.28	2.52	1.20	.85	1.60	1.35	1.22
28					7.15	6.12	2.48	1.22	.82	1.60	1.45	1.20
29					7.35	5.78	2.68	1.08	.80	1.62	1.30	1.18
30					7.12	5.68	2.58	1.00	1.00	1.60	.85	1.20
31					6.92		2.48	1.00		1.55		1.20
1907.												
1	1.92	2.00	2.05	3.25	4.35	6.95	8.08	4.35	2.35	1.82	1.95	1.60
2	1.85	1.92	2.20	3.10	4.15	6.82	8.10	4.20	2.28	1.90	1.95	1.55
3	1.55	1.95	2.15	3.18	4.05	7.12	8.22	4.00	2.20	1.95	1.90	1.48
4	1.70	2.08	2.58	3.25	3.92	7.78	8.20	3.90	2.20	2.00	1.90	1.40
5	1.50	2.08	2.68	3.58	3.92	7.95	8.05	3.85	2.15	2.02	1.85	1.42
6	1.78	2.28	2.52	3.72	3.92	8.22	8.08	3.75	2.08	2.10	1.85	1.45
7	1.85	2.35	2.60	3.82	3.90	8.78	7.92	3.98	2.00	2.10	1.88	1.45
8	1.92	2.52	2.60	3.82	3.85	9.10	7.78	3.75	1.98	2.15	1.90	1.62
9	1.88	2.48	2.60	3.68	3.80	9.22	7.52	3.48	1.95	2.10	1.85	1.52
10	1.70	2.40	2.60	3.38	3.85	9.18	7.28	3.32	2.00	2.18	1.78	1.35
11	1.80	2.45	2.60	3.35	3.85	8.62	7.12	3.18	2.05	2.20	1.72	1.42
12	1.88	2.45	2.60	3.80	4.12	8.32	6.92	3.05	2.08	2.22	1.58	1.50
13	1.90	2.42	2.60	4.52	4.80	8.30	6.60	3.00	1.98	2.22	1.42	1.45
14	1.92	2.38	2.32	4.95	5.28	8.50	6.38	2.90	1.88	2.20	1.30	1.50
15	1.98	2.42	2.22	4.92	5.52	8.62	6.38	2.82	1.78	2.20	1.30	.82
16	1.92	2.40	2.30	5.10	5.42	8.80	6.68	2.70	1.70	2.10	1.30	1.00
17	1.85	2.42	2.35	5.50	5.25	8.95	6.45	2.78	1.70	2.08	1.30	1.10
18	1.98	2.45	2.52	5.68	5.22	8.92	6.02	2.70	1.70	2.05	1.38	.75
19	1.85	2.48	3.18	5.38	5.55	8.90	5.55	2.62	1.75	2.05	1.52	1.10
20	1.78	2.60	3.80	4.92	6.30	8.90	5.25	2.60	1.80	2.02	1.42	1.00
21	1.70	2.78	5.25	4.25	7.00	8.65	5.05	2.60	1.75	1.92	1.45	1.40
22	1.88	2.75	6.50	4.08	7.65	8.58	4.95	2.58	1.75	1.95	1.30	1.28
23	1.75	2.85	7.00	4.10	8.18	8.52	4.90	2.52	1.80	1.95	1.22	1.30
24	1.88	2.82	5.90	4.08	8.60	8.60	4.88	2.50	1.70	1.92	1.30	1.38
25	1.90	2.78	4.90	4.20	8.60	8.40	4.80	2.42	1.68	1.90	1.30	1.40
26	1.90	2.82	4.52	4.10	8.48	8.38	4.68	2.38	1.70	1.88	1.38	1.42
27	1.82	2.65	4.40	4.18	7.90	8.30	4.62	2.30	1.38	1.85	1.50	1.45
28	1.98	2.22	3.90	4.05	7.50	8.15	4.88	2.38	1.38	1.85	1.50	1.40
29	1.92		3.40	4.25	7.32	8.20	5.02	2.35	1.52	1.88	1.55	1.40
30	1.95		3.40	4.35	7.22	8.02	4.98	2.48	1.65	1.90	1.68	1.40
31	1.98		3.35		7.05		4.68	2.38		1.95		1.40

[a] The following gage heights for this station for 1906 were missing in the 1906 report (Water-Supply Paper 208): January 1, 1.12 feet; January 2, 1.05 feet; January 3, 0.85 foot; January 4, 1.12 feet; January 5, 1.40 feet; January 6, 1.40 feet.

Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1905, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1.35	1.5	1.65	2.5	3.25	5.5	4.5	3.0	2.15	1.7	2.3	1.1
2	1.35	1.5	1.65	2.45	3.3	5.5	5.2	3.0	2.1	1.7	2.3	1.2
3	1.4	1.5	1.75	2.9	3.35	5.6	5.05	2.8	2.0	1.75	2.35	1.7
4	1.4	1.5	1.8	2.7	3.4	5.5	5.0	2.8	1.95	1.8	2.35	1.8
5	1.4	1.5	1.7	2.2	3.6	5.4	5.0	2.7	1.85	1.8	2.3	1.9
6	1.4	1.5	1.65	2.2	3.7	5.3	4.95	2.5	1.8	1.8	2.25	1.9
7	1.35	1.5	1.65	2.35	3.5	5.2	5.0	2.4	1.75	1.95	2.15	1.7
8	1.35	1.5	1.65	2.5	3.5	5.15	4.95	2.4	1.75	1.95	2.1	1.5
9	1.35	1.55	1.65	2.6	3.6	5.2	4.9	2.4	1.7	1.95	2.15	1.5
10	1.35	1.55	1.7	2.7	3.95	5.2	4.7	2.4	1.65	1.95	2.15	1.65
11	1.35	1.55	1.7	2.7	4.1	5.35	4.5	2.5	1.65	2.0	1.85	1.4
12	1.35	1.5	1.7	2.9	4.0	5.5	4.1	2.4	1.6	2.0	1.3	1.1
13	1.35	1.5	1.7	3.1	3.9	5.65	3.7	2.5	1.7	1.95	1.4	1.3
14	1.35	1.5	1.8	3.1	3.75	5.9	3.5	3.2	1.8	1.9	1.5	1.6
15	1.35	1.55	1.9	3.3	3.7	6.0	3.5	3.2	2.1	1.8	1.4	1.9
16	1.35	1.6	2.15	3.55	3.65	6.15	3.7	3.3	2.1	1.8	1.7	1.8
17	1.35	1.6	2.35	3.7	3.6	6.3	3.6	3.1	1.9	1.8	1.95	1.55
18	1.35	1.55	2.6	3.9	3.7	6.4	3.4	3.0	1.9	1.9	1.95	1.15
19	1.4	1.55	2.6	4.0	3.9	6.4	3.2	3.0	1.8	1.9	2.0	1.6
20	1.5	1.5	2.6	4.1	3.9	6.5	3.15	3.0	1.7	2.1	1.95	1.5
21	1.5	1.5	2.6	4.1	4.25	6.55	3.05	3.05	1.65	2.1	2.0	1.7
22	1.5	1.5	2.55	4.15	4.5	6.5	2.85	3.0	1.55	2.2	2.0	1.65
23	1.5	1.5	2.5	4.3	4.3	6.4	2.7	4.0	1.55	2.15	1.95	1.85
24	1.5	1.5	2.5	4.4	4.25	6.4	2.55	3.6	1.5	2.0	1.9	2.0
25	1.5	1.5	2.6	4.45	4.35	6.3	2.5	3.4	1.5	2.05	1.9	1.9
26	1.5	1.5	2.7	4.05	4.85	6.2	2.4	2.95	1.6	2.1	1.8	2.2
27	1.5	1.55	2.7	3.9	5.25	6.25	2.3	2.8	1.65	2.2	1.6	2.3
28	1.5	1.6	2.65	3.65	5.4	3.4	2.3	2.6	2.05	2.3	1.65	2.15
29	1.5	1.6	2.65	3.5	5.5	3.5	2.5	2.4	1.85	2.25	1.5	2.1
30	1.5	.....	2.6	3.4	5.45	3.6	2.95	2.3	1.8	2.2	1.4	2.2
31	1.5	.....	2.5	.....	5.4	.....	2.5	2.2	.....	2.2	.....	2.2

NOTE.—River frozen over after November 29, 1905. Ice conditions January 1 to February 27, 1907, and December 15, 1907, to February 29, 1908, and after November 12, 1908. On February 17, 1908, the ice was 12 inches thick. There was a little ice March 5 to 15, 1908, which probably did not materially affect the gage heights. The flow was affected at times from April to July, 1908, by gate regulation of the Pathfinder Tunnel.

Rating table for North Platte River at Pathfinder, Wyo., for 1905 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	168	2.10	714	3.40	1,630	5.40	4,020
.90	192	2.20	774	3.50	1,720	5.60	4,360
1.00	218	2.30	836	3.60	1,810	5.80	4,730
1.10	245	2.40	900	3.70	1,900	6.00	5,110
1.20	276	2.50	966	3.80	2,000	6.20	5,515
1.30	313	2.60	1,032	3.90	2,100	6.40	5,935
1.40	354	2.70	1,100	4.00	2,200	6.60	6,360
1.50	397	2.80	1,168	4.20	2,400	6.80	6,800
1.60	444	2.90	1,236	4.40	2,600	7.00	7,240
1.70	494	3.00	1,308	4.60	2,830	8.00	9,440
1.80	546	3.10	1,382	4.80	3,100	9.00	11,650
1.90	600	3.20	1,460	5.00	3,400		
2.00	656	3.30	1,540	5.20	3,700		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 10 discharge measurements made in 1905–1907, and is well defined. Above gage height 6.6 feet the rating curve is a tangent, the difference being 2.20 per tenth.

Monthly discharge of North Platte River at Pathfinder, Wyo., for 1905 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
May 10–31	8,010	2,020	4,790	209,000	A.
June	12,800	4,500	8,800	524,000	A.
July	4,050	953	1,800	111,000	A.
August	1,110	218	597	36,700	A.
September	444	168	249	14,800	A.
October	469	260	349	21,500	A.
November 1–28	556	245	413	22,900	A.
The period				940,000	
1906.					
April	4,820	1,790	3,030	180,000	A.
May	12,000	2,350	6,180	380,000	A.
June	11,000	3,180	7,390	440,000	A.
July	3,250	913	2,260	139,000	A.
August	933	434	666	41,000	A.
September	1,020	397	664	39,500	A.
October	1,050	305	575	35,400	A.
November 1–17	1,020	685	873	29,400	A.
The period				1,280,000	
1907.					
March	7,240	685	1,890	116,000	A.
April	4,500	1,380	2,440	145,000	A.
May	10,800	2,000	5,070	312,000	A.
June	12,100	6,840	10,300	613,000	A.
July	9,920	2,850	6,010	370,000	A.
August	2,550	836	1,380	84,800	A.
September	868	346	587	34,900	A.
October	786	557	669	41,100	A.
November	628	283	440	26,200	A.
December	454	157	315	19,400	C.
The period				1,760,000	
1908.					
January			292	18,000	D.
February			318	20,000	D.
March	1,100	469	759	46,700	B.
April	2,660	774	1,620	96,400	A.
May	4,180	1,500	2,370	146,000	A.
June	6,250	1,630	4,590	273,000	A.
July	3,700	836	2,030	125,000	A.
August	2,200	774	1,210	74,400	A.
September	744	397	544	32,400	A.
October	836	494	645	39,700	A.
November 1–15	868	313	666	19,800	B.
The period				891,000	

NOTE.—Discharge estimated December 21, 1907, to February 29, 1908. This is the only ice period for which there is sufficient data to warrant even an approximate estimate of discharge.

NORTH PLATTE RIVER AT GUERNSEY, WYO.

This station, which was established June 14, 1900, to obtain statistical data concerning the flow of the river, was originally located at the highway bridge about one-half mile northwest of Guernsey, Wyo., in sec. 35, T. 27 N., R. 66 W., but at the opening of the season of 1902 the gage was removed to the railroad bridge, 300 feet above the first location. Discharge measurements have been made from the highway bridge. During the last few years the records obtained have been especially valuable to the United States Reclamation Service in connection with the North Platte project.

The station is located about 15 miles above the mouth of Laramie River. No other important tributaries come in anywhere in the vicinity of the station. The drainage area above the station is about 16,000 square miles, and the elevation of the gage zero is 4,317 feet above sea level. The station was abandoned November 30, 1908.

Very little irrigation is practiced along the North Platte proper above this point, but there are many diversions for irrigation on the tributary streams. The canal systems of the North Platte project will divert water a few miles below the station.

At the beginning of the season of 1902, when the gage was removed to the new location, the datum was changed. This gage was washed out by flood waters on June 1, 1908, and was replaced on June 13, 1908, by another rod gage at the same location but with the datum 1 foot lower.

About June 3, 1908, a maximum height of 11.50 feet (old gage datum), said to be the highest for over twenty years, was recorded.

Owing to the shifting character of the channel, comparatively frequent measurements are necessary to obtain the best results.

During the winter seasons the river is frequently covered with ice a foot or more in thickness, and results are affected by ice for about three months each year.

Discharge measurements of North Platte River at Guernsey, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	J. M. Giles	193	399	1.30	1,020
March 25	do	310	1,340	4.00	7,850
March 26	do	310	1,260	3.85	7,270
April 12	do	309	758	2.37	2,910
1908.					
May 26	U. S. Reclamation Service			3.20	5,810
June 10	do				6,040
June 17	do			5.70	6,990
June 18	W. B. Freeman	308	1,500	5.60	6,590
June 19	do	308	1,500	5.60	6,500
July 2	U. S. Reclamation Service			3.20	2,400
July 6	do			3.90	3,600
July 20	do			2.90	1,950
August 18	do			2.90	1,530
September 18	do			1.90	530
October 6	do			1.90	565
October 14	do			2.00	556

NOTE.—Beginning with measurement of June 17, 1908, gage heights refer to new gage, the datum of which is 1 foot lower than that of old gage.

Daily gage height, in feet, of North Platte River at Guernsey, Wyo., for 1907 and 1908.

[W. F. Peterson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.00	.....	.....	2.65	2.50	5.85	5.70	2.60	1.00	0.92	0.80	2.20
2	.90	.....	.....	2.45	2.60	5.80	5.60	2.58	1.00	.82	.80	2.20
3	.95	.....	.....	2.35	2.67	5.72	5.55	2.45	1.00	.80	.80	2.18
4	.65	.....	.....	2.30	2.72	5.85	5.50	2.35	1.00	.80	.80	2.15
5	.75	.....	1.30	2.30	2.62	6.00	5.50	2.28	1.00	.80	.85	2.12
6	.85	.....	1.30	2.30	2.55	6.10	5.50	2.15	1.00	.80	.90	2.10
7	1.00	.....	1.35	2.30	2.50	6.15	5.40	1.90	1.00	.80	.95	2.10
8	.85	.....	1.50	2.30	2.45	6.40	5.35	1.88	.95	.80	1.00	2.10
9	1.00	.....	1.50	2.40	2.32	6.50	5.30	1.80	.95	.85	1.05	2.10
10	1.00	.....	1.50	2.40	2.30	6.90	5.00	1.68	1.00	.85	1.10	2.10
11	1.00	.....	1.50	2.40	2.30	7.00	4.85	1.60	1.00	.90	1.10	2.10
12	1.00	.....	1.50	2.37	2.25	6.88	4.75	1.58	1.00	.90	1.20	2.00
13	1.00	.....	1.52	2.32	2.42	6.75	4.62	1.50	1.00	.95	1.20	2.00
14	1.00	.....	1.50	2.30	2.55	6.45	4.40	1.45	1.00	.95	1.20	2.00
15	1.00	.....	1.50	2.30	2.72	6.35	4.00	1.35	1.00	1.00	1.22	2.00
16	1.00	.....	1.50	2.60	3.10	6.40	4.00	1.30	.98	1.00	1.25	2.00
17	1.00	.....	1.47	3.10	3.60	6.40	4.20	1.30	.95	1.00	1.30	1.90
18	1.10	.....	1.42	3.40	3.80	6.42	4.00	1.28	.80	1.00	1.50	1.90
19	1.60	.....	1.40	3.50	3.87	6.55	3.98	1.20	.80	1.00	1.52	1.88
20	.....	.....	1.40	3.45	3.70	6.50	3.75	1.20	.80	1.00	1.60	1.85
21	.....	.....	1.85	3.30	3.75	6.40	3.75	1.12	.80	1.00	1.65	1.85
22	.....	.....	2.30	3.25	4.05	6.32	3.35	1.08	.75	1.00	1.80	1.80
23	.....	.....	2.80	3.15	4.52	6.30	3.15	1.00	.75	1.00	1.80	1.80
24	.....	.....	3.70	2.85	4.95	6.25	3.05	1.00	.75	1.00	1.85	1.80
25	.....	.....	4.10	2.70	5.40	6.20	3.10	1.00	.75	1.00	1.88	1.80
26	.....	.....	3.80	2.70	5.90	6.15	2.85	1.00	.80	1.00	1.90	1.80
27	.....	.....	3.45	2.60	6.15	6.00	2.75	1.00	.90	.95	2.00	1.85
28	.....	.....	3.10	2.60	6.12	5.90	2.62	1.00	1.00	.92	2.00	1.82
29	.....	.....	2.95	2.50	6.00	5.85	2.50	1.00	1.00	.90	2.25	1.80
30	.....	.....	2.90	2.50	6.00	5.70	2.55	1.55	1.00	.85	2.30	1.80
31	.....	.....	2.80	.....	5.95	.....	2.70	1.00	.....	.80	.....	1.80
1908.[a]												
1	1.8	1.8	1.2	1.15	2.0	.....	3.45	2.4	2.4	1.8	2.2	.....
2	1.8	1.8	1.2	1.0	2.0	.....	3.2	2.4	2.3	1.8	2.2	.....
3	1.8	1.8	1.15	1.0	2.0	.....	3.2	2.45	2.3	1.8	2.2	.....
4	1.8	1.8	1.0	1.0	1.9	.....	3.65	2.35	2.2	2.0	2.2	.....
5	1.8	1.8	.9	1.0	1.9	.....	4.0	2.4	2.1	1.9	2.2	.....
6	1.8	1.8	.9	1.05	1.9	.....	3.95	2.4	2.05	1.9	2.2	.....
7	1.8	1.8	.9	1.2	1.9	.....	3.9	2.4	2.0	1.9	2.2	.....
8	1.8	1.8	.8	1.05	1.9	.....	3.85	2.4	2.0	1.9	2.2	.....
9	1.8	1.8	.8	1.0	2.1	.....	3.7	2.4	2.0	2.0	2.2	.....
10	1.8	1.8	.85	1.0	2.0	.....	3.7	2.35	2.0	2.0	2.15	.....
11	1.8	1.8	.95	1.0	2.0	.....	3.65	2.2	1.95	2.0	2.1	.....
12	1.8	1.8	1.0	1.0	2.15	.....	3.55	2.2	1.9	2.0	2.0	.....
13	1.8	1.8	1.0	1.15	2.35	.....	3.45	2.25	1.9	2.0	2.0	.....
14	1.8	1.8	1.0	1.2	2.45	5.65	3.2	2.45	1.9	2.0	1.9	.....
15	1.8	1.8	1.0	1.3	2.55	5.8	3.1	2.5	1.8	2.0	1.9	.....
16	1.8	1.8	1.15	1.4	2.6	5.75	3.05	2.5	1.8	2.0	1.95	.....
17	1.8	1.8	1.2	1.4	2.5	5.7	2.95	2.7	1.8	2.0	2.0	.....
18	1.8	1.75	1.2	1.55	2.3	5.7	2.8	2.9	1.9	2.0	2.2	.....
19	1.8	1.7	1.2	1.75	2.2	5.6	2.85	2.75	1.9	2.05	2.3	.....
20	1.8	1.7	1.2	1.9	2.1	5.6	2.9	2.7	1.9	2.1	2.4	.....
21	1.8	1.7	1.2	2.0	2.0	5.6	2.8	2.7	2.0	2.1	2.4	.....
22	1.8	1.65	1.15	2.1	2.0	5.85	2.75	2.6	1.9	2.1	2.4	.....
23	1.8	1.6	1.1	2.2	2.15	6.05	2.65	2.6	1.9	2.1	2.4	.....
24	1.8	1.6	1.1	2.25	2.75	5.55	2.6	2.55	1.9	2.1	2.4	.....
25	1.8	1.6	1.05	2.3	3.45	5.45	2.5	2.7	1.9	2.15	2.4	.....
26	1.8	1.55	1.0	2.45	3.25	5.35	2.45	2.9	1.85	2.2	2.4	.....
27	1.8	1.45	1.2	2.55	3.1	5.2	2.4	2.85	1.8	2.2	2.4	.....
28	1.8	1.35	1.2	2.6	3.9	4.9	2.35	2.75	1.8	2.2	2.4	.....
29	1.8	1.2	1.25	2.35	5.5	4.55	2.3	2.6	1.8	2.2	2.4	.....
30	1.8	.....	1.25	2.2	5.3	4.0	2.35	2.5	1.8	2.2	2.4	.....
31	1.8	.....	1.3	.....	.....	.....	2.4	2.4	.....	2.2	.....	.....

[a] Gage washed out June 1, 1908, by high water that reached a maximum gage height of 11.5 feet on June 2 or 3, 1908. New gage installed June 14, 1908.

NOTE.—Probable ice conditions existed January 1 to March 4, 1907, November 16, 1907, to March 1, 1908, and after November 17, 1908. On February 1, 1908, the ice was 14 inches thick.

Rating tables for North Platte River at Guernsey, Wyo.

MARCH 5 TO MAY 22, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	1,020	2.10	2,340	2.90	4,200	3.70	6,720
1.40	1,100	2.20	2,540	3.00	4,480	3.80	7,080
1.50	1,310	2.30	2,750	3.10	4,770	3.90	7,460
1.60	1,460	2.40	2,970	3.20	5,070	4.00	7,850
1.70	1,620	2.50	3,200	3.30	5,380	4.10	8,250
1.80	1,790	2.60	3,440	3.40	5,700		
1.90	1,970	2.70	3,690	3.50	6,030		
2.00	2,150	2.80	3,940	3.60	6,370		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and one made in 1906 and is well defined between gage heights 1.3 feet and 4.1 feet.

MAY 23 TO NOVEMBER 17, 1907.

0.70	750	2.00	2,550	3.30	5,180	5.20	10,100
.80	850	2.10	2,730	3.40	5,410	5.40	10,740
.90	960	2.20	2,920	3.50	5,650	5.60	11,320
1.00	1,080	2.30	3,110	3.60	5,890	5.80	11,900
1.10	1,200	2.40	3,300	3.70	6,130	6.00	12,500
1.20	1,330	2.50	3,500	3.80	6,380	6.20	13,100
1.30	1,460	2.60	3,700	3.90	6,640	6.40	13,700
1.40	1,600	2.70	3,900	4.00	6,900	6.60	14,300
1.50	1,750	2.80	4,100	4.20	7,420	6.80	14,920
1.60	1,900	2.90	4,310	4.40	7,950	7.00	15,550
1.70	2,060	3.00	4,520	4.60	8,490		
1.80	2,220	3.10	4,730	4.80	9,030		
1.90	2,380	3.20	4,950	5.00	9,590		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is developed from the form of the curve used in the latter part of 1906 and the relation of the curves in the first part of the year to the latter part. It is not well defined, but is probably a fairly close approximation. No discharge measurements were made during this period.

MARCH 1 TO MAY 31, 1908.

0.80	730	1.90	2,440	3.00	5,170	4.20	9,560
.90	850	2.00	2,650	3.10	5,480	4.40	10,440
1.00	980	2.10	2,860	3.20	5,800	4.60	11,320
1.10	1,110	2.20	3,080	3.30	6,130	4.80	12,200
1.20	1,250	2.30	3,310	3.40	6,470	5.00	13,100
1.30	1,390	2.40	3,550	3.50	6,820	5.20	14,000
1.40	1,540	2.50	3,800	3.60	7,180	5.40	14,900
1.50	1,700	2.60	4,060	3.70	7,550	5.60	15,800
1.60	1,870	2.70	4,330	3.80	7,930		
1.70	2,050	2.80	4,600	3.90	8,320		
1.80	2,240	2.90	4,880	4.00	8,720		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of the curve used in the earlier part of 1907 and is not well defined.

JUNE 14 TO JULY 24, 1908.

2.60	1,570	3.40	2,670	4.20	4,000	5.60	5,470
2.70	1,690	3.50	2,830	4.30	4,180	5.20	5,850
2.80	1,820	3.60	2,990	4.40	4,360	5.40	6,250
2.90	1,950	3.70	3,150	4.50	4,540	5.60	6,670
3.00	2,080	3.80	3,310	4.60	4,720	5.80	7,090
3.10	2,220	3.90	3,480	4.70	4,900	6.00	7,510
3.20	2,370	4.00	3,650	4.80	5,090		
3.30	2,520	4.10	3,820	4.90	5,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during this period, and is fairly well defined.

JULY 25 TO AUGUST 14, 1908.

[Indirect method for shifting channels used.]

AUGUST 15 TO NOVEMBER 17, 1908.

1.80	500	2.10	650	2.40	940	2.70	1,280
1.90	540	2.20	740	2.50	1,050	2.80	1,400
2.00	580	2.30	840	2.60	1,160	2.90	1,530

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is not well defined.

Daily discharge, in second-feet, of North Platte River at Guernsey, Wyo., for 1908.

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1		1,120	11		840	21		
2		1,120	12		840	22		
3		1,180	13		890	23		
4		1,060	14		1,100	24		
5		1,120	15			25	1,350	
6		1,120	16			26	1,290	
7		1,120	17			27	1,230	
8		1,040	18			28	1,170	
9		1,040	19			29	1,110	
10		990	20			30	1,170	
						31	1,230	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River at Guernsey, Wyo., for 1907 and 1908.

[Drainage area, 16,200 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 5–31	8,250	1,020	2,720	0.168	0.17	146,000	B.
April	6,030	2,750	3,650	.225	.25	217,000	B.
May	13,000	2,640	6,430	.397	.46	395,000	B.
June	15,200	11,600	13,300	.821	.92	791,000	C.
July	11,600	3,500	7,510	.464	.53	462,000	B.
August	3,700	1,080	1,850	.114	.13	114,000	C.
September	1,080	800	994	.061	.07	59,100	D.
October	1,080	850	981	.061	.07	60,300	D.
November 1–16	1,400	850	1,100	.068	.04	34,900	D.
The period						2,230,000	
1908.							
March	1,390	730	1,090	.067	.08	67,000	B.
April	4,060	980	1,960	.121	.14	117,000	B.
May	17,000	2,440	4,690	.289	.33	288,000	C.
June	30,000	3,650	10,500	.648	.72	625,000	D.
July	3,650	1,110	2,240	.138	.16	138,000	B.
August	1,530	840	1,150	.071	.08	70,700	B.
September	940	500	583	.036	.04	34,700	B.
October	740	500	614	.038	.04	37,800	B.
November 1–17	740	540	670	.041	.03	22,600	B.
The period						1,400,000	

NOTE.—Discharges May 31 to June 13, 1908, interpolated. These interpolations are based on an estimated flood discharge of 30,000 second-feet on June 3 and the measurement made on June 10, 1908.

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station, which was established June 3, 1901, to replace the station at Gering, is located at a highway bridge 1 mile south of Mitchell, Nebr., in sec. 27, T. 23 N., R. 56 W. The records at this point show the amount of water passing the Wyoming-Nebraska state line, and are of especial value in connection with interstate questions concerning the distribution of water. Laramie River and Rawhide Creek enter the river in Wyoming below the Guernsey station, and Horse Creek comes in just below the state line. No important tributaries enter below the station. Important diversions for irrigation are made both above and below the station.

The datum of the gage was lowered 1 foot May 3, 1902, to obviate negative readings. As the river sometimes freezes solid, few records have been obtained during the winter.

As the bed of the river is of shifting sand, and the measurements are insufficient in number to indicate all changes, the results obtained are unsatisfactory.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 5	Arthur Dobson	999	1,460	3.50	3,680
May 23	A. R. Dobson	1,040	2,270	4.02	7,040
June 14	Arthur Dobson	1,050	3,780	5.25	13,800
July 17	do	998	2,030	3.90	6,000
August 28	do	814	600	2.65	1,300
September 19	do	638	337	2.42	726
October 23	Adna Dobson	669	411	2.45	844
1908.					
February 27	Adna Dobson	592	505	2.53	904
March 16	do	738	494	2.35	956
April 23	G. W. Bates	875	653	2.50	1,330
June 1	Adna Dobson	1,020	3,980	5.35	16,800
June 16	Arthur Dobson	1,030	2,250	4.02	7,340
July 10	do	972	1,170	2.89	2,805
July 28	do	700	425	2.35	866
August 29	do	762	510	2.40	992
September 17	Adna Dobson	180	65	1.60	61
October 30	do	462	201	1.98	305
November 19	G. W. Bates	588	410	2.27	766
Do	do	610	404	2.25	732
December 31[a]	L. F. Flower	694	449	2.34	509

[a] Slush ice affected discharge measurement.

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1907 and 1908.

[B. H. Newbold, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		3.7	3.3	5.0	4.8	3.3	.....	2.6	2.4	.....
2		3.6	3.4	.....	4.7	3.3	2.7	2.5	2.4	2.3
3		3.6	3.4	5.0	4.7	3.3	2.6	2.5	.....	2.3
4		3.5	3.4	4.9	4.7	.....	2.6	2.4	2.4	2.3
5		3.5	.....	5.0	4.6	3.2	2.6	2.4	2.4	2.3
6		3.5	3.4	5.0	4.6	3.1	2.6	.....	2.4	2.4
7		3.5	3.3	5.1	.....	3.0	2.6	2.4	2.4	2.4
8		3.5	3.3	5.2	4.5	3.0	.....	2.4	2.4	.....
9		3.5	3.3	.....	4.6	3.0	2.6	2.4	2.4	2.4
10		3.4	3.3	5.3	4.6	3.0	2.6	2.4	.....	2.4
11		3.4	3.3	5.5	4.5	.....	2.6	2.4	2.4	2.4
12		3.4	.....	5.5	4.4	3.0	2.6	2.4	2.4	2.4
13		3.4	3.3	5.5	4.3	2.9	2.5	.....	2.4	2.4
14		.....	3.3	5.2	.....	2.9	2.5	2.4	2.4	2.4
15		3.3	3.3	5.1	4.3	2.8	.....	2.4	2.4	.....
16		3.4	3.4	.....	4.1	2.8	2.5	2.4	2.4	.....
17		3.5	3.5	5.0	3.9	2.8	2.5	2.4	.....	.....
18		3.6	3.8	4.9	3.8	.....	2.4	2.4	2.4	.....
19		3.6	.....	4.9	3.9	2.7	2.4	2.4	2.4	.....
20		3.7	3.9	4.8	3.9	2.7	2.4	.....	2.4	.....
21		.....	3.9	4.8	.....	2.7	2.4	2.4	2.4	.....
22		3.8	3.9	4.8	3.7	2.7	.....	2.4	2.4	.....
23		3.8	4.0	.....	3.7	2.7	2.4	2.4	2.4	.....
24		3.7	4.4	4.8	3.5	2.7	2.4	2.4	.....	.....
25		3.5	4.5	4.8	3.5	.....	2.4	2.4	2.4	.....
26		3.4	.....	4.8	3.5	2.7	2.4	2.4	2.4	.....
27		3.4	5.1	4.9	3.5	2.7	2.4	.....	2.4	.....
28		.....	5.2	4.9	.....	2.7	2.4	2.4	2.4	.....
29		3.3	5.1	4.8	3.4	2.7	.....	2.4	2.3	.....
30		3.3	5.1	.....	3.3	2.6	2.5	2.4	2.3	.....
31		.....	5.0	.....	3.3	2.7	.....	2.4	.....	.....

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	.....	2.5	2.7	5.1	3.4	2.3	2.2	1.5	.....	2.4
2	2.25	2.5	2.7	6.0	3.0	.....	2.1	1.5	2.2	2.4
3	2.25	2.5	.....	5.0	2.9	2.4	2.1	1.5	2.3	2.5
4	2.25	2.5	2.6	5.8	2.8	2.4	2.1	.....	2.3	2.7
5	2.35	.....	2.7	4.4	.....	2.4	2.1	1.5	2.3	2.8
6	2.55	2.5	2.6	4.2	3.1	2.3	.....	1.5	2.3	.....
7	2.55	2.5	2.6	.....	3.1	2.4	2.1	1.5	2.3	2.8
8	.....	2.5	2.6	4.0	3.0	2.4	2.1	1.5	.....	2.7
9	2.25	2.5	2.5	3.9	3.0	.....	2.0	1.5	2.3	2.5
10	2.25	2.4	.....	3.9	3.0	2.3	2.0	1.5	2.4	2.4
11	2.25	2.4	2.6	3.8	2.9	2.3	2.0	.....	2.4	2.4
12	2.25	.....	2.7	3.7	.....	2.3	2.0	1.5	2.4	2.4
13	2.35	2.3	2.8	3.7	3.1	2.2	.....	1.6	2.3	.....
14	2.35	2.3	2.8	.....	2.9	2.3	2.0	1.7	2.4	2.4
15	.....	2.3	2.8	3.8	2.8	2.3	1.9	1.7	.....	2.5
16	2.35	2.2	2.9	3.8	2.8	.....	1.9	1.7	2.5	2.5
17	2.2	2.2	.....	3.7	2.8	2.2	1.6	1.7	2.7	2.5
18	2.3	2.2	3.0	3.8	2.7	2.2	1.6	.....	2.8	2.4
19	2.3	.....	2.9	3.9	.....	2.3	1.5	1.7	2.3	2.4
20	2.3	2.3	2.8	3.9	2.6	2.3	.....	1.8	2.3	.....
21	2.4	2.3	2.7	.....	2.5	2.3	1.5	1.9	2.4	2.4
22	.....	2.4	2.7	3.8	2.7	2.3	1.5	1.9	.....	2.4
23	2.4	2.4	2.7	3.8	2.6	.....	1.5	2.0	2.5	2.5
24	2.4	2.5	.....	3.9	2.5	2.3	1.5	2.0	2.5	2.5
25	2.5	2.6	3.0	3.8	2.5	2.3	1.4	.....	2.5	2.5
26	2.4	.....	3.5	3.7	.....	2.3	1.4	2.0	2.4	2.6
27	2.4	2.7	3.4	3.7	2.5	2.3	.....	1.9	2.3	.....
28	2.4	2.9	3.4	.....	2.4	2.3	1.4	1.9	2.3	2.6
29	.....	3.0	4.05	3.6	2.3	2.4	1.5	1.8	.....	2.5
30	2.4	2.8	4.7	3.6	2.3	.....	1.5	1.8	2.3	2.4
31	2.5	.....	.....	.....	2.3	2.3	.....	1.8	.....	2.4

Rating tables for North Platte River near Mitchell, Nebr.

APRIL 1 TO MAY 26, 1907.

[Daily discharges were obtained by the indirect method for shifting channels.]

MAY 27 TO DECEMBER 14, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	600	3.20	2,930	4.10	7,070	5.00	12,270
2.40	760	3.30	3,310	4.20	7,610	5.10	12,890
2.50	930	3.40	3,700	4.30	8,160	5.20	13,510
2.60	1,130	3.50	4,120	4.40	8,720	5.30	14,140
2.70	1,360	3.60	4,570	4.50	9,290	5.40	14,770
2.80	1,620	3.70	5,030	4.60	9,880	5.50	15,400
2.90	1.910	3.80	5,510	4.70	10,470		
3.00	2,230	3.90	6,010	4.80	11,060		
3.10	2,570	4.00	6,540	4.90	11,660		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during this period and the form of the 1906 curve, and is well defined between gage heights 2.4 feet and 5.25 feet.

MARCH 2 TO DECEMBER 31, 1908.

1.40	25	2.60	1,510	3.80	6,160	5.00	13,900
1.50	40	2.70	1,780	3.90	6,670	5.10	14,700
1.60	61	2.80	2,070	4.00	7,200	5.20	15,520
1.70	90	2.90	2,380	4.10	7,750	5.30	16,360
1.80	130	3.00	2,700	4.20	8,330	5.40	17,220
1.90	210	3.10	3,050	4.30	8,940	5.50	18,100
2.00	330	3.20	3,430	4.40	9,570	5.60	19,000
2.10	470	3.30	3,830	4.50	10,230	5.70	20,000
2.20	630	3.40	4,250	4.60	10,930	5.80	21,000
2.30	810	3.50	4,700	4.70	11,650	5.90	22,000
2.40	1,020	3.60	5,170	4.80	12,380	6.00	23,000
2.50	1,260	3.70	5,660	4.90	13,130		

NOTE.—The above table is not applicable for ice conditions. It is based on 12 discharge measurements made during this period and is not well defined above gage height 4.0 feet.

Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1907.

Day.	Apr.	May.	Day.	Apr.	May.	Day.	Apr.	May.
1	4,600	3,300	11	3,400	3,400	21	5,200	6,350
2	4,100	3,700	12	3,450	3,400	22	5,400	6,350
3	4,100	3,700	13	3,450	3,450	23	5,400	6,850
4	3,700	3,800	14	3,250	3,450	24	4,900	9,000
5	3,750	3,800	15	3,050	3,450	25	4,000	9,600
6	3,800	3,800	16	3,500	3,900	26	3,600	10,200
7	3,800	3,400	17	3,950	4,300	27	3,600	.....
8	3,800	3,400	18	4,400	5,750	28	3,500	.....
9	3,800	3,400	19	4,400	6,000	29	3,300	.....
10	3,400	3,400	20	4,900	6,300	30	3,300	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River near Mitchell, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	5,400	3,050	3,960	236,000	B.
May	13,500	3,300	6,190	381,000	B.
June	15,400	11,100	12,400	738,000	B.
July	11,100	3,310	7,110	437,000	B.
August	3,310	1,130	1,920	118,000	B.
September	1,360	760	960	57,100	B.
October	1,130	760	783	48,100	B.
November	760	600	749	44,600	B.
December 1–14	760	600	703	19,500	B.
The period				2,080,000	
1908.					
March	1,380	630	931	57,200	C.
April	2,700	630	1,210	72,000	B.
May	12,700	1,260	2,980	183,000	B.
June	23,000	5,170	7,950	473,000	B.
July	4,250	810	2,030	125,000	B.
August	1,020	630	815	50,100	B.
September	630	25	229	13,600	C.
October	330	40	121	7,440	D.
November	1,260	330	898	53,400	B.
December	1,020	510	859	52,800	D.
The period				1,090,000	

NOTE.—Discharge was interpolated for days on which gage was not read.

NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

This station, which was established October 5, 1894, to determine the amount of water below all diversions contributed by the North Platte to the Platte, is located 3½ miles above the junction of North and South Platte rivers at a highway bridge about one-half mile north of the city of North Platte, in sec. 28, T. 14 N., R. 30 W. The gage is at the Union Pacific Railway bridge, 2 miles below.

Many diversions are made between this point and the Mitchell station. One small tributary, Birchwood Creek, maintains a small flow of water at the gaging station at times when the river itself would otherwise be dry.

The drainage area is 28,500 square miles.

During the winter the river often freezes solid, as it is very shallow. Records at this station are subject to the same limitations of shifting

channel and poor measuring conditions as other stations on the river, though to a somewhat less degree.

The datum of the gage has remained unchanged since the station was established.

Discharge measurements of North Platte River at North Platte, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4	Arthur Dobson	1,720	2,260	2.65	5,830
May 24	A. R. Dobson	1,940	2,890	2.88	7,910
June 16	Arthur Dobson	1,970	4,710	3.70	16,000
July 16	do	1,940	3,190	3.35	9,270
September 1	do	408	772	1.80	1,500
September 21	do	355	493	1.65	1,020
November 8	Adna Dobson	1,080	670	2.00	1,400
1908.					
March 5	G. W. Bates	1,100	950	2.25	1,860
April 24	do	1,010	704	2.10	1,580
June 2	Adna Dobson	1,900	5,010	3.85	14,000
June 17	Arthur Dobson	1,810	2,830	3.20	7,330
July 12	do	1,050	1,160	2.60	2,960
July 29	do	665	490	1.80	1,050
August 30	do	512	283	1.85	553
September 16	Adna Dobson	150	124	1.42	206
October 31	A. A. Dobson	650	588	2.05	1,150
November 21	G. W. Bates	1,020	1,160	2.30	2,590

Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1907 and 1908.

[Henry Deck and C. P. Miller, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1			2.38	3.40	3.32	2.30	1.95	2.25	1.80	1.80
2			2.40	3.40	3.30	2.40	2.10	2.10	1.80	1.80
3		2.60	2.48	3.40	3.30	2.45	2.00	2.10	1.80	1.80
4		2.60	2.50	3.40	3.30	2.40	2.00	2.10	1.80	1.80
5		2.60	2.42	3.40	3.30	2.30	1.90	2.00	1.82	1.90
6		2.60	2.38	3.30	3.30	2.20	1.85	1.90	1.88	1.90
7		2.58	2.30	3.30	3.30	2.10	1.80	1.90	1.88	1.90
8		2.55	2.35	3.30	3.25	2.10	1.80	1.85	1.90	1.95
9		2.50	2.40	3.40	3.25	2.10	1.78	1.82	2.00	1.95
10		2.45	2.40	3.50	3.22	2.00	1.75	1.80	2.00	2.00
11		2.45	2.38	3.40	3.18	1.90	1.75	1.80	2.00	2.00
12		2.40	2.30	3.40	3.15	1.88	1.72	1.80	2.00	2.00
13		2.35	2.20	3.60	3.00	1.86	1.70	1.80	2.05	2.00
14		2.40	2.20	3.60	3.00	1.85	1.70	1.80	2.15	2.00
15		2.35	2.20	3.60	3.00	1.85	1.70	1.80	2.20	.....
16		2.35	2.20	3.60	3.00	1.85	1.70	1.80	2.20	.....
17		2.38	2.20	3.40	3.00	1.85	1.70	1.80	2.30	.....
18		2.35	2.20	3.35	2.95	1.85	1.70	1.80	2.30	.....
19		2.35	2.20	3.25	2.90	1.85	1.70	1.80	2.25	.....
20		2.35	2.25	3.15	2.88	1.85	1.70	1.80	2.20	.....
21		2.52	2.58	3.10	2.80	1.85	1.70	1.80	2.15	.....
22		2.55	2.78	3.15	2.70	1.85	1.65	1.80	2.05	.....
23		2.60	2.82	3.25	2.65	1.85	1.65	1.85	2.00	.....
24		2.60	2.90	3.30	2.62	1.85	1.60	1.85	2.00	.....
25		2.60	2.95	3.32	2.60	1.85	1.60	1.90	2.00	.....
26		2.62	2.90	3.55	2.48	1.85	1.65	1.85	2.00	.....
27		2.58	2.90	3.60	2.45	1.85	1.80	1.85	2.00	.....
28		2.52	2.95	3.60	2.42	1.88	1.85	1.85	1.90	.....
29		2.42	3.20	3.55	2.40	2.02	1.95	1.82	1.90	.....
30		2.40	3.42	3.38	2.35	2.05	2.10	1.80	1.90	.....
31		.....	3.40	.....	2.30	2.00	.....	1.80	.....	.....

[a] Ice conditions after November 13, 1907.

Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]										
1	2.	2.2	2.1	4.1	2.9	1.7	1.7	1.45	1.9	1.8
2	2.2	2.2	2.25	4.1	2.9	1.7	1.7	1.4	1.95	1.8
3	2.25	2.1	2.3	4.0	2.85	1.6	1.7	1.4	2.0	1.8
4	2.3	2.1	2.4	4.7	2.0	1.5	1.6	1.35	2.0	1.8
5	2.3	2.1	2.5	4.5	2.0	1.5	1.6	1.35	2.0	1.8
6	2.3	2.1	2.6	4.55	2.3	1.5	1.4	1.35	2.0	1.8
7	2.3	2.2	2.5	3.6	2.2	1.5	1.35	1.4	2.0	1.8
8	2.25	2.2	2.5	3.2	2.0	1.7	1.3	1.45	2.0	1.8
9	2.2	2.1	2.45	3.1	2.0	1.6	1.2	1.55	2.0	1.8
10	2.05	2.1	2.4	3.0	2.0	1.6	1.2	1.6	2.0	1.8
11	2.25	2.1	2.4	3.0	2.0	1.6	1.3	1.6	2.0	1.9
12	2.4	2.1	2.5	3.0	2.4	1.6	1.3	1.6	2.6	1.9
13	2.3	2.1	2.6	3.25	2.5	1.6	1.3	1.6	2.3	2.0
14	2.3	2.1	2.7	3.0	2.5	1.6	1.4	1.6	2.1	2.0
15	2.1	2.1	2.6	3.0	2.2	1.6	1.4	1.6	2.0	2.0
16	1.9	2.1	2.4	3.0	2.2	1.6	1.4	1.6	2.0	2.1
17	1.9	2.1	(b)	3.05	2.1	1.6	1.4	1.55	2.0	2.1
18	1.9	2.1	(b)	3.35	2.0	1.6	1.4	1.55	2.1	2.2
19	2.1	2.1	(b)	3.0	2.0	1.6	1.4	2.5	2.3	2.3
20	2.25	2.1	(b)	3.0	2.0	1.9	1.5	2.6	2.4	2.3
21	2.2	2.1	3.4	3.0	2.0	1.9	1.4	2.6	2.5	2.4
22	2.05	2.1	3.4	2.85	2.0	1.8	1.4	2.35	2.6	2.4
23	2.1	2.1	3.65	3.15	1.9	1.8	1.4	2.15	2.5	2.4
24	2.1	1.9	3.6	3.0	1.9	1.8	1.4	2.1	2.4	2.4
25	2.1	1.9	3.6	3.35	1.9	1.8	1.4	1.95	2.3	2.4
26	2.1	2.0	3.6	3.0	1.8	2.0	1.4	1.9	2.2	2.4
27	2.15	2.1	3.6	3.0	1.75	2.0	1.3	1.8	2.1	2.4
28	2.2	2.1	3.6	3.2	1.8	2.0	1.3	1.8	2.0	2.4
29	2.2	2.1	3.6	3.0	1.8	2.0	1.4	1.9	1.9	2.4
30	2.2	2.2	3.6	3.0	1.8	1.8	1.4	1.9	1.85	2.4
31	2.2	.....	3.7	.....	1.8	1.8	.....	1.85	.....	2.4

[a] Gage heights for August and September, 1908, uncertain. [b] High water May 17–20, 1908, no readings.

Daily discharge, in second-feet, of North Platte River at North Platte, Nebr., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	.....	4,200	12,800	10,600	2,900	2,100	3,600	800	800
2	.....	.....	4,350	12,800	10,300	3,500	2,800	2,800	800	800
3	.....	5,500	4,900	12,800	10,200	3,800	2,350	2,800	800	800
4	.....	5,500	5,000	12,800	10,100	3,600	2,350	2,800	800	800
5	.....	5,500	4,500	12,800	10,000	3,100	1,900	2,300	850	1,100
6	.....	5,500	4,300	11,800	9,900	2,600	1,700	1,600	1,000	1,100
7	.....	5,350	3,800	11,800	9,800	2,200	1,500	1,600	1,000	1,100
8	.....	5,150	4,100	11,800	9,200	2,200	1,500	1,450	1,100	1,100
9	.....	4,800	4,400	12,800	9,100	2,250	1,450	1,400	1,400	1,100
10	.....	4,500	4,400	13,800	8,800	1,900	1,300	1,300	1,400	1,100
11	.....	4,500	4,300	12,800	8,350	1,500	1,300	1,300	1,400	1,100
12	.....	4,200	3,800	12,800	8,000	1,450	1,250	1,300	1,400	1,100
13	.....	4,000	3,350	14,900	6,700	1,350	1,200	1,300	1,400	1,100
14	.....	4,300	3,350	14,900	6,650	1,400	1,200	1,100	1,400	1,100
15	.....	4,000	3,350	14,900	6,500	1,400	1,200	1,100	1,400	.....
16	.....	4,000	3,350	14,900	6,400	1,400	1,200	1,100	1,400	.....
17	.....	4,150	3,350	12,800	6,500	1,500	1,200	1,100	1,400	.....
18	.....	4,000	3,350	12,300	6,200	1,500	1,200	1,100	1,400	.....
19	.....	4,000	3,350	11,200	5,900	1,500	1,200	1,100	1,400	.....
20	.....	4,000	3,600	10,100	5,800	1,500	1,200	1,100	1,400	.....
21	.....	5,000	5,600	9,650	5,300	1,500	1,200	1,100	1,400	.....
22	.....	5,200	7,100	10,000	4,800	1,500	1,000	1,000	1,400	.....
23	.....	5,600	7,400	10,600	4,500	1,600	1,000	1,100	1,400	.....
24	.....	5,600	8,100	11,100	4,300	1,600	900	1,100	1,400	.....
25	.....	5,600	8,500	11,200	4,300	1,600	900	1,300	1,400	.....
26	.....	5,800	8,100	13,500	3,600	1,600	1,000	1,100	1,400	.....
27	.....	5,500	8,100	13,900	3,500	1,650	1,500	1,100	1,400	.....
28	.....	5,100	8,500	13,800	3,400	1,750	1,700	1,100	1,100	.....
29	.....	4,500	10,800	13,200	3,350	2,400	2,100	1,050	1,100	.....
30	.....	4,350	13,000	11,300	3,100	2,600	2,800	800	1,100	.....
31	.....	.....	12,800	.....	2,900	2,300	.....	800	.....	.....

Daily discharge, in second-feet, of North Platte River at North Platte, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	1,670	1,820	1,440	17,100	4,900	780	320	220	740	780
2	1,670	1,820	2,000	17,100	4,900	780	320	180	850	780
3	1,860	1,450	2,240	15,900	4,500	460	380	160	990	780
4	2,080	1,450	2,700	25,500	750	310	270	130	1,100	780
5	2,080	1,450	3,270	22,600	750	310	270	130	1,100	780
6	2,080	1,450	3,850	23,300	1,650	310	140	130	1,100	670
7	2,080	1,820	3,270	11,200	1,250	310	140	160	1,100	670
8	1,860	1,820	3,270	7,300	700	630	120	180	1,100	670
9	1,670	1,450	3,000	6,550	700	460	70	250	1,160	670
10	1,150	1,450	2,700	5,800	700	460	70	300	1,160	670
11	1,860	1,580	2,450	5,800	700	360	130	300	1,160	.....
12	2,550	1,580	3,100	5,800	2,000	360	130	300	4,000	.....
13	2,080	1,580	3,700	7,800	2,450	360	130	300	2,300	.....
14	2,080	1,580	4,300	5,800	2,450	360	190	300	1,600	.....
15	1,300	1,580	3,700	5,800	1,530	360	200	270	270	.....
16	750	1,580	2,450	5,800	1,530	360	200	270	1,250	.....
17	750	1,580	.....	6,200	1,180	360	200	240	1,250	.....
18	850	1,580	.....	8,700	1,120	360	200	240	1,600	.....
19	1,450	1,580	.....	5,800	1,120	270	200	3,200	2,600	.....
20	2,030	1,580	.....	5,800	1,120	780	270	3,800	3,150	.....
21	1,830	1,580	9,400	5,800	1,120	780	200	3,800	3,750	.....
22	1,280	1,580	9,400	4,550	1,120	570	180	2,350	4,400	.....
23	1,450	1,580	12,000	7,000	1,070	570	180	1,520	3,750	.....
24	1,450	940	11,500	5,600	1,070	570	180	1,350	3,150	.....
25	1,450	940	11,500	8,450	1,070	570	180	900	2,600	.....
26	1,450	1,230	11,500	5,600	800	1,050	180	740	2,130	.....
27	1,630	1,580	11,500	5,600	900	860	150	530	1,720	.....
28	1,820	1,580	11,500	7,200	1,050	860	150	530	1,370	.....
29	1,820	1,580	11,500	5,600	1,050	860	180	740	1,050	.....
30	1,820	1,960	11,200	5,600	1,050	460	180	740	900	.....
31	1,820	.....	12,300	.....	1,050	460	.....	630	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River near North Platte, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April 3–30	5,800	4,000	4,830	268,000	B.
May	13,000	3,350	5,710	351,000	B.
June	14,900	9,650	12,500	744,000	B.
July	10,600	2,900	6,710	413,000	C.
August	3,800	1,350	2,020	124,000	D.
September	2,800	900	1,510	89,800	B.
October	3,600	800	1,450	89,200	D.
November	1,400	800	1,240	73,800	D.
December 1–14	1,100	800	1,010	28,000	D.
The period	.....	.....	.....	2,180,000	
1908.					
March	2,550	750	1,670	103,000	D.
April	1,960	940	1,540	91,600	C.
May (27 days)	12,300	1,440	6,320	338,000	D.
June	25,500	4,550	9,220	549,000	C.
July	4,900	700	1,530	94,100	D.
August	1,050	270	527	32,400	D.
September	380	70	190	11,300	D.
October	3,800	130	803	49,400	D.
November	4,400	740	1,850	110,000	D.
December 1–10	780	670	725	14,400	D.
The period	.....	.....	.....	1,390,000	

PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

From the point of junction of North and South Platte rivers the main stream winds eastward across Nebraska for over 200 miles, uniting with the Missouri at Plattsmouth, about 10 miles south of Omaha. Its course lies chiefly through broad, level bottom lands, rather sandy in places, but for the most part fertile, bordered by bluffs varying in height from 50 to 300 or 400 feet. From its source to a point near Ashland, Saunders County, it is a broad, shallow stream, flowing in many places as a network of interlacing channels among numerous islands and sand bars, but farther east it is confined between heavily wooded limestone bluffs. The average fall is about 6 feet per mile.

The average annual precipitation is about 23 inches, of which 69 per cent falls during the five months of the growing season, from April to August and about one-half of the remainder is snowfall. The evaporation averages about 4½ feet. The stream is subject to periodic floods caused by melting of snows in the headwaters regions of North and South Platte rivers. These floods reach a maximum in June and July and often do considerable damage to property on the lower portions of the stream. In the western part of the drainage area the waters of the stream are extensively used for irrigation.

The Loup and its branches, which form the most important tributaries of the Platte below the forks, drain an area 13,540 square miles in extent, lying in the heart of Nebraska. The Loup proper is formed by the junction of North and Middle Loup rivers, which unite near the city of St. Paul, the middle Loup in turn receiving the South Loup in the southwestern part of Howard County. The principal tributaries are Beaver, Cedar, Calamus, and Dismal creeks. A comparatively small amount of water is diverted for irrigation, the ditches generally being small and covering limited areas. A number of power plants are in operation and others of considerable extent have been proposed, particularly one near Columbus, by which it is believed that about 20,000 continuous horsepower may be developed.

The records of the Survey indicate 1905 as a year of high water, and 1902 and 1908 as low-water years. On Loup River the flow was probably lowest in 1895.

The following gaging stations have been maintained in this section of the Platte basin:

Platte River near Lexington, Nebr., 1902–1906.
Platte River at Columbus, Nebr., 1895–1908.
Platte River near South Bend, Nebr., 1903.
Loup River at Columbus, Nebr., 1894–1908.

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Middle Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
North Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
Elkhorn River near Norfolk, Nebr., 1896–1903.
Elkhorn River near Arlington, Nebr., 1898–1903
South Fork of Elkhorn River near Norfolk, Nebr., 1896.

PLATTE RIVER AT COLUMBUS, NEBR.

This station, which was established June 4, 1895, and has been kept continuously since that date except during the winter months, is located above the mouth of Loup River, at Meridian bridge, about 3 miles south of Columbus, in sec. 31, T. 17 N., R. 1 E. No important tributaries enter the river between the junction of the North Platte and the South Platte and this station, and Loup River and Elkhorn River are the only large tributaries below. The drainage area is 56,900 square miles.

In the late summer practically all the water of the river disappears, either from diversion or evaporation from the wide shallow channels. No records have been obtained during the ice period of the winter.

The bed of the river is of shifting sand and at low water the stream flows in many shallow channels, so that determination of discharge is largely a matter of estimation. Poor measuring conditions, combined with shifting channel, render the records liable to considerable error. The gage datum has remained the same throughout.[a]

Discharge measurements of Platte River at Columbus, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of action.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 3	Arthur Dobson	2,070	2,720	3.40	6,360
May 14	F. S. Dobson	1,860	864	2.60	1,860
June 20	Arthur Dobson	2,300	5,010	4.60	14,600
July 24	do	2,260	3,240	3.74	8,420
August 23	do	1,000	411	1.75	758
September 14	do	630	265	1.60	514
October 12	do	1,510	816	2.35	1,760
November 26	G. W. Bates	1,930	1,363	2.80	2,890
1908.					
March 3	Dobson and Bates	1,750	2,320	3.66	6,660
April 20	Arthur Dobson	1,130	883	2.66	1,520
May 5	G. W. Bates	860	494	2.23	845
June 10	Arthur Dobson	2,320	5,380	4.48	13,900
July 1	do	2,210	2,890	3.73	6,970
July 22	do	1,550	1,540	2.97	3,210
August 22	G. W. Bates	1,180	1,050	2.70	2,130
September 12	Arthur Dobson	70	32	.....	33.4
October 10	do	.....	.....	1.65	[b] 65.0
November 6	do	560	456	2.30	861

[a] Data collected at this station prior to 1908 have been compiled in Water-Supply Paper 230, Surface water supply of Nebraska.
[b] Estimated.

Daily gage height, in feet, of Platte River at Columbus, Nebr., for 1907 and 1908.

[W. D. Benson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1			3.2	4.25	4.25	3.0	2.6	2.8	2.5	2.65
2		2.85	3.0	4.35	4.3	2.95	2.35	2.8	2.4	2.6
3		3.35	3.15	4.45	4.15	2.9	2.45	2.85	2.4	2.6
4		3.15	3.35	4.5	4.1	3.0	2.4	3.0	2.45	2.75
5		3.40	3.1	4.5	4.05	2.95	2.3	2.8	2.3	2.75
6		3.55	3.3	4.8	4.05	3.1	2.35	2.7	2.3	2.7
7		3.45	3.2	4.95	4.2	3.25	2.1	2.4	2.3	2.65
8		3.25	3.0	4.55	4.1	3.35	2.05	2.25	2.35	2.65
9		3.1	3.0	4.35	4.2	3.15	1.9	2.35	2.25	2.55
10		3.15	2.85	4.75	4.0	2.9	1.85	2.35	2.15	3.5
11		2.75	3.0	5.5	4.0	3.05	1.75	2.3	2.5	
12		2.65	3.05	4.45	4.05	2.85	1.7	2.3	2.45	
13		2.65	2.65	4.7	4.1	3.05	1.55	2.2		
14		2.7	2.65	4.75	4.15	3.0	1.35	2.15	2.15	
15		2.5	2.7	4.6	4.1	2.6	1.3	2.15	2.05	
16		2.5	2.7	4.65	4.25	2.6	1.3	2.1	2.10	
17		2.5	2.65		4.4	2.55	1.2	2.2	2.2	
18		2.65	2.5	4.85	4.45	2.4	1.25	2.3	2.4	
19		2.7	2.55	4.85	4.0	2.25	1.25	2.45	2.5	
20		2.85	2.6	4.55	3.85	2.05	1.1	2.35	2.6	
21		2.9	2.65	4.35	3.65	2.0	1.1	2.3	2.65	
22		2.85	2.65	4.2	3.55	1.95	1.1	2.35	2.7	
23			2.6	4.15	3.9	1.85	1.1	2.4	2.65	
24		2.6	3.25	4.0	3.85	1.85	1.05	2.35	2.7	
25		2.9	3.25	4.05	3.65	1.9	.95	2.4	2.9	
26		3.35	3.7	4.05	3.5	1.95	.95	2.45		
27		3.25	3.9	4.05	3.6	1.5	1.4	2.45	2.8	
28		3.25	3.65	4.0	3.65	1.65	1.6	2.5	2.7	
29		3.35	3.8	4.2	3.55	2.3	1.65	2.5	2.6	
30		3.4	3.85	4.25	3.4	2.0			2.55	
31			3.9		3.15	1.95				
1908.										
1	6.2	2.3	1.8	3.15	3.75	1.85	1.65	0.8	2.35	
2	6.25	2.3	1.75	3.2	3.95	2.0	1.6	.7	2.3	
3	3.65	2.45	1.55	3.1	3.8	1.95	1.5	.7	2.25	2.3
4	3.1	2.55	2.05	3.65	3.9	1.75	1.3	.7	2.25	
5	2.95	2.45	2.35	4.6	3.65	1.55			2.25	
6	3.0	2.4	2.6	4.75	3.8	1.6		1.9	2.25	
7	3.0	2.55	2.7	5.95	3.9	1.5		1.75	2.3	
8	2.3	2.65	3.0	5.85	4.2	1.4		1.85	2.3	
9	3.0	2.45	3.0	4.8	3.8	1.4			2.3	
10	2.75	2.3	3.0	4.65	3.45			1.6	2.25	
11	2.6	2.35	3.4	4.4	3.5	1.35		1.5	2.0	2.55
12	2.55	2.35	2.95	4.3	3.0	1.85		1.45	1.95	2.55
13	2.5	2.5	2.9	4.3	3.0	1.9	.65	1.4	1.9	2.25
14	2.35	2.3	2.95	4.35	2.8	2.1	.75	1.3	1.95	2.85
15	2.35	2.25	2.85	4.3		2.5	.8		2.0	2.9
16	2.45	2.15	2.95	4.3	2.3	2.15	.8		2.15	2.9
17	2.7	2.45	2.9	4.3	2.95	1.85	.8		2.2	2.95
18	2.6	2.45	2.95	4.35	2.6	1.8	.8	1.3	2.2	2.95
19	2.55	2.55	3.0	4.2	2.55	2.25	.7		2.3	2.85
20	2.65	2.65	3.2	4.2	2.55	2.75	.8	1.8	2.4	
21	2.45	2.35	3.0	4.2	2.75	2.65	.8	1.75	2.4	
22	2.45	2.45	2.95	4.1	2.95	2.55		1.6	2.4	
23	2.4	2.4	2.6	4.1	3.15	2.55	.5	1.5	2.5	2.8
24	2.4	2.3	2.85	4.15	2.75	2.35	.5	1.5	2.5	2.8
25	2.4	2.2	2.95	3.9	2.6	2.3	.6	1.5		2.8
26	2.3	2.15	2.95	3.9	2.85	2.2	1.3	2.6	2.95	2.8
27	2.4	2.05	3.1	3.95	2.8	2.1	1.05	2.8	2.9	2.9
28	2.4	2.1		3.95	2.55	2.2	1.05	2.8	2.9	3.05
29	2.45	2.05	3.15	3.85	2.5	2.2	1.05	2.7	2.85	3.15
30	2.45	2.0	2.95	3.65	2.2	1.95	.8	2.5	2.7	3.2
31	2.45		3.1		2.05	1.65		2.35		3.25

NOTE.—Probable ice conditions January to March, 1907, December 10, 1907, March 2, 1908, December, 1908.

Rating tables for Platte River at Columbus, Nebr.

APRIL 1 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	1,600	3.30	5,500	4.10	11,150	4.90	17,300
2.60	1,900	3.40	6,150	4.20	11,900	5.00	18,100
2.70	2,300	3.50	6,850	4.30	12,650	5.10	18,900
2.80	2,750	3.60	7,550	4.40	13,400	5.20	19,700
2.90	3,200	3.70	8,250	4.50	14,150	5.30	20,500
3.00	3,700	3.80	8,950	4.60	14,900	5.40	21,300
3.10	4,250	3.90	9,650	4.70	15,700	5.50	22,100
3.20	4,850	4.00	10,400	4.80	16,500		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is fairly well defined.

AUGUST 1 TO DECEMBER 31, 1907.

0.90	50	1.60	510	2.30	1,650	3.00	3,700
1.00	80	1.70	650	2.40	1,860	3.10	4,250
1.10	125	1.80	800	2.50	2,080	3.20	4,850
1.20	175	1.90	950	2.60	2,310	3.30	5,500
1.30	235	2.00	1,100	2.70	2,570	3.40	6,150
1.40	310	2.10	1,270	2.80	2,900	3.50	6,850
1.50	400	2.20	1,460	2.90	3,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is well defined between gage heights 1.6 feet and 2.8 feet.

MARCH 3 TO JULY 8, 1908.

1.50	170	2.60	1,420	3.70	6,900	4.80	17,290
1.60	225	2.70	1,670	3.80	7,680	4.90	18,370
1.70	290	2.80	1,960	3.90	8,490	5.00	19,460
1.80	365	2.90	2,320	4.00	9,340	5.20	21,650
1.90	450	3.00	2,750	4.10	10,230	5.40	23,870
2.00	540	3.10	3,220	4.20	11,170	5.60	26,130
2.10	640	3.20	3,730	4.30	12,130	5.80	28,430
2.20	755	3.30	4,270	4.40	13,120	6.00	30,750
2.30	890	3.40	4,860	4.50	14,140		
2.40	1,040	3.50	5,500	4.60	15,170		
2.50	1,210	3.60	6,170	4.70	16,220		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during this period and is fairly well defined between gage heights 2.2 feet and 4.5 feet. Below gage height 2.2 feet it is very uncertain.

JULY 9 TO AUGUST 31, 1908.

1.30	200	2.00	790	2.70	2,180	3.40	5,520
1.40	255	2.10	920	2.80	2,520	3.50	6,160
1.50	320	2.20	1,060	2.90	2,900	3.60	6,840
1.60	395	2.30	1,220	3.00	3,340	3.70	7,550
1.70	475	2.40	1,400	3.10	3,830	3.80	8,300
1.80	565	2.50	1,620	3.20	4,360		
1.90	670	2.60	1,880	3.30	4,920		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and the form of the preceding curve. It is not well defined.

Monthly discharge of Platte River at Columbus, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	7,200	1,600	3,770	224,000	B.
May	9,650	1,600	4,450	274,000	B.
June	22,100	10,400	14,000	833,500	B.
July	13,800	4,550	10,000	615,000	B.
August	5,820	400	2,500	154,000	B.
September	2,310	65	756	45,000	B.
October	3,700	1,270	1,990	122,000	B.
November	3,280	1,180	2,030	121,000	B.
December 1-14	2,740	2,200	2,430	67,500	C.
The period				2,460,000	
1908.					
March	6,540	890	1,930	119,000	C.
April	1,540	540	991	59,000	D.
May	4,860	198	2,350	144,000	C.
June	30,200	3,220	11,800	702,000	C.
July	11,200	855	4,250	261,000	C.
August	2,350	228	888	54,600	D.
The period				1,340,000	

NOTE.—There are not sufficient data for computing discharges for September to December, 1908.

LOUP RIVER AT COLUMBUS, NEBR.

This station, which was established October 13, 1894, is located at the highway bridge in the outskirts of Columbus and about 5 miles above the mouth of the river, in sec. 25, T. 17 N., R. 1 W.

The records show the total discharge of the river at its mouth, and are valuable in connection with power development. They show also the remarkably uniform flow of the stream. A comparatively small amount of water is diverted for irrigation.

Records have usually been suspended during the winter months on account of the severe ice conditions.

Measurements at this station are rough at best, owing to the soft and constantly shifting bed and the high and uneven velocity. Gage heights are only an approximate index of discharge, as the swift current changes the channel very rapidly, and at least one measurement a week would be required to give even fairly good results.

No daily discharges have been computed for 1907 and 1908, as any computation based on the data at hand would be misleading, and a fair idea of the discharge can be obtained from the discharge measurements. Two gages have been used at this station: A chain gage at the highway bridge has been used since 1904, and a staff gage at the former cable location, 1½ miles above, was used prior to that time. No changes in datum have been made.

Discharge measurements of Loup River at Columbus, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 3	Arthur Dobson	667	1,040	4.46	2,720
May 14	F. S. Dobson	600	948	4.40	2,850
June 20	Arthur Dobson	677	1,200	4.75	5,450
July 23	do	595	1,080	4.80	3,390
August 23	do	606	770	4.40	1,810
September 14	do	532	846	4.60	2,620
October 12	do	445	588	4.52	2,120
November 26	G. W. Bates	338	598	4.50	2,650
1908.					
March 3	Dobson and Bates	830	1,300	4.56	3,510
April 20	Arthur Dobson	866	1,210	4.74	3,140
May 5	G. W. Bates	676	843	4.58	2,840
June 7	Adna Dobson	860	2,010	5.65	9,920
June 10	Arthur Dobson	860	1,600	5.25	7,620
July 1	do	850	929	4.35	2,780
July 22	do	700	942	4.27	2,270
August 22	G. W. Bates	790	1,170	4.44	2,890
October 10	A. A. Dobson	800	1,080	4.60	2,380
November 6	do	860	850	4.45	2,580
December 29[a]	do	140	516	4.72	2,300

[a] Slush ice.

Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1907 and 1908.

[W. D. Benson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1			4.4	4.7	4.6	4.55	4.7	5.2	4.9	4.8
2		4.35	4.35	4.85	4.45	4.6	4.65	5.1	4.95	4.65
3		4.45	4.45	5.0	4.45	4.6	4.6	4.9	4.5	4.85
4		4.4	4.55	4.7	4.4	4.7	4.6	4.9	4.8	4.8
5		4.5	4.55	4.85	4.4	4.55	4.65	4.7	4.7	4.75
6		4.6	4.45	4.85	4.5	4.55	4.65	4.65	4.7	4.7
7		4.55	4.4	4.9	4.7	.....	4.55	4.55	4.8	4.65
8		4.5	4.3	4.7	5.25	6.05	4.55	4.45	4.85	4.75
9		4.4	4.4	4.85	4.85	5.5	4.55	4.4	4.8	4.85
10		4.3	4.4	5.4	4.7	4.25	4.55	4.4	4.7	4.8
11		4.35	4.4	5.05	4.55	4.05	4.65	4.45	4.55	.....
12		4.25	4.45	4.9	4.5	4.05	4.65	4.6	4.4	.....
13		4.3	4.4	4.95	4.5	4.05	4.65	4.4	.....	.....
14		4.25	4.45	4.95	4.9	4.25	4.55	4.5	4.4	4.7
15		4.25	4.5	4.9	5.4	4.35	4.6	4.45	.....	.....
16		4.35	4.45	4.85	6.0	4.65	4.65	4.4	4.4	.....
17		4.45	4.65	.....	4.8	4.45	4.5	4.55	4.6	.....
18		4.55	4.65	5.1	5.2	.....	4.6	4.55	4.55	.....
19		4.45	4.6	4.7	5.35	4.25	4.6	4.55	4.5	.....
20		4.4	4.65	4.9	5.1	4.2	4.55	4.7	4.8	.....
21		4.4	4.7	4.9	5.05	4.25	4.65	4.7	4.7	.....
22		4.4	4.75	4.55	4.85	4.25	4.7	4.75	4.6	.....
23		.....	4.85	4.45	4.8	4.4	4.65	4.7	4.5	.....
24		4.4	5.55	4.45	4.85	4.45	4.6	4.7	4.55	.....
25		4.6	5.2	4.55	4.9	4.4	4.6	4.6	4.3	.....
26		4.65	5.2	4.65	4.65	4.55	4.6	4.65	.....	.....
27		4.5	5.5	4.35	4.6	4.45	4.8	4.55	4.55	.....
28		4.5	4.8	4.6	4.7	4.7	4.9	4.5	4.55	.....
29		4.6	4.85	4.75	4.7	4.75	5.0	4.5	4.6	.....
30		4.55	4.9	4.75	4.65	4.85	.....	.....	4.7	.....
31		.....	4.7	.....	4.6	4.85	.....	4.7	.....	.....

Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1907 and 1908—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	4.75	4.45	4.25	4.7	4.35	4.15	3.1	4.3	4.35	.....
2	5.0	4.6	4.3	5.0	4.45	3.95	4.45	4.3	4.45	4.05
3	4.4	4.55	4.3	4.45	4.65	4.05	4.25	4.25	4.45	4.05
4	4.4	4.55	4.55	4.6	4.5	4.05	4.35	4.2	4.45	4.05
5	4.4	4.5	4.95	7.2	4.4	4.0	4.25	4.5	4.45	4.6
6	.....	4.5	4.85	6.25	4.4	4.1	4.2	5.0	4.45	4.85
7	4.7	4.8	4.75	5.95	4.55	4.1	4.2	4.55	4.45	4.7
8	4.7	4.55	4.45	6.0	4.6	4.1	4.2	4.6	4.5	4.7
9	4.6	4.6	4.45	5.45	4.5	4.25	4.15	.....	4.45	4.85
10	4.55	4.6	4.4	5.2	4.3	4.3	4.15	4.5	4 45	4.85
11	4.6	4.5	4.8	4.95	4.3	4.4	4.15	4.55	4.5	4.9
12	4.6	4.7	4.5	5.5	4.35	5.1	4.15	4.6	4.5	.....
13	4.6	4.6	4.45	5.4	4.15	4.45	4.15	4.5	4.45	5.2
14	4.65	4.6	4.6	5.15	4.1	4.85	4.15	4.5	4.25	5.1
15	4.6	4.65	4.65	5.3	.....	5.3	4.15	4.5	4.25	5.05
16	4.65	4.6	4.55	4.85	4.3	5.95	4.2	4.5	4.4	4.95
17	4.4	4.85	4.75	4.85	4.25	4.6	4.2	4.5	4.45	4.8
18	4.35	4.65	4.75	5.3	4.2	4.6	4.2	4.5	4.65	4.7
19	4.55	.....	4.7	5.2	4.2	4.75	4.15	.....	4.55	4.65
20	4.4	4.75	4.6	4.85	4.25	4.4	4.25	4.6	4.5	4.45
21	4.6	4.75	4.4	4.45	4.2	4.5	4.2	4.75	4.55	4.45
22	4.45	4.7	4.35	4.55	4.2	4.75	4.25	4.65	4.55	4.35
23	4.55	4.6	4.55	6.25	4.45	4.4	4.2	4.65	4.6	4.6
24	4.5	4.5	4.5	5.55	4.25	4.4	4.2	4.45	4.65	4.55
25	4.45	4.45	4.7	4.9	4.3	4.4	4.2	4.35	.....	4.55
26	4.25	4.65	4.75	4.8	4.75	4.45	4.25	4.35	4.55	4.6
27	4.55	4.35	4.8	4.25	4.85	4.45	4.35	4.35	4.35	4.65
28	4.5	4.5	4.9	4.2	4.85	4.45	4.4	4.25	4.45	4.6
29	4.5	4.2	5.15	4.1	4.6	4.45	4.5	4.2	4.65	4.7
30	4.45	4.2	4.75	4.15	4.4	4.35	4.25	4.2	4.5	4.65
31	4.3	.....	4.9	.....	4.2	4.3	.....	4.3	.....	4.65

NOTE.—These gage heights afford only an approximate index of discharge. Owing to the extremely shifting character of the river bed no daily discharges can be computed that will be in any way reliable.
Probable ice conditions January to March, 1907, December 11, 1907, to February 29, 1908, and December, 1908.

SOUTH PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

The South Platte rises in the mountainous region surrounding the large basin near the center of the State of Colorado, known as South Park, and in the long eastern slopes of the high mountains forming the Continental Divide. The river might properly be said to be formed at South Platte, Colo., by the junction of the North and South forks. The drainage area of the South Fork comprises about 2,150 square miles, and that of the North Fork only about 450 square miles, but there is little difference in the mean annual flow of the two branches. The North Fork is about 50 miles long and the South Fork a little over 100 miles. Geneva Creek, with a drainage area of 50 square miles, is the most important tributary of the North Fork, other tributaries being Deer Park, Elk, and Buffalo creeks. Tarryall Creek and Goose Creek are the principal tributaries of the South Fork.

South Fork, usually considered the main branch of the river, flows in an easterly direction to Lake George, then northward to its junction with the North Fork, and on to the mouth of the Cache la Poudre

near Greeley. From Greeley its general course is eastward, until it joins the North Platte at the town of North Platte, Nebr.

At the mouth of the South Platte its elevation is 2,800 feet above sea level; 100 miles above the mouth it is 3,600 feet; at Denver, 288 miles above the mouth, it is 5,170 feet; and at South Platte about 6,100 feet. Lake George, about 50 miles up the South Fork, is 8,000 feet above sea level, and Cheesman Reservoir, 23 miles up from South Platte, is 6,850 feet. At the mouth of Geneva Creek, at Grant, Colo., 40 miles up the North Fork from South Platte, the elevation is about 8,500 feet.

The drainage basin, which comprises about 20,000 square miles above Julesburg, Colo., is bisected in an irregular way by the channel of the South Platte. To the north and west lies the mountainous portion, which consists of a long, narrow strip, extending in a north-south direction from a point a short distance above the south boundary of Wyoming to Palmer Lake, Colo. This area furnishes at least 90 per cent of the total run-off of the basin. South and east of the river the basin lies entirely within the plains region.

The mountainous region consists of peaks and jagged masses of granite, with sedimentary rocks cut and gashed by stream channels along the foothills. The stream gradients are steep, and many of the streams consist of series of cascades and rapids. The soil cover as a whole is light, and except during spring freshets or heavy storms the streams are remarkably free from sediment in suspension.

The lower basin, somewhat scarred and broken along the foothills, gradually merges farther east into the undulating prairies so characteristic of the Great Plains east of the Rocky Mountains. The soils of the plains are the product of the disintegration of shales and sandstones, and range from adobe clays to sandy loams. The controlling vegetation is largely native grasses, the only timber being a few bunches of scraggly cottonwoods along the stream channels and small patches of pine, cedar, and piñon along the higher portions.

The forest cover of the mountains, consisting originally of coniferous trees, is rapidly disappearing, but through the occurrence of fires a foothold has been furnished for the deciduous aspen, which is gradually increasing its dominion. Most of the timber land in this drainage is included in the Pike and Medicine Bow national forests; in all there are probably 1,000 square miles of merchantable timber lands.

The tributaries of the South Platte comprise, first, the small streams that rise on the eastern slope of the Rocky Mountains, and, second, the plains streams. The mountain streams furnish a perennial supply of water, the amount of which, however, varies with the snowfall, being light during the latter part of the summer and in the fall and winter, and large during the spring floods. This water is almost

entirely diverted for irrigation and does not reach the South Platte except in times of heavy floods. The principal streams of this class are Bear, Clear, Boulder, and St. Vrain creeks and Big Thompson and Cache la Poudre rivers. The plains streams are all intermittent in their nature and furnish water only during storms or in the season of melting snow. The chief streams of this class are Cherry, Lone Tree, Kiowa, Box Elder, Bijou, Beaver, and Pawnee creeks.

In the mountainous regions the flow of the South Platte is perennial, but in the plains area the volume is greatly diminished by the numerous irrigation diversions. At North Platte, Nebr., just above the mouth of the river, the stream channel is dry for the greater part of the year, or consists of several small channels carrying a few second-feet of water.

The river is subject to periodic floods that occur in May and June, the magnitude varying from year to year with seasonal precipitation and temperature. At Julesburg, Colo., the stream flow varies from nothing up to 12,000 second-feet.

The rainfall is 25 inches or more in the highest mountains; 15 to 20 inches between altitudes of 5,500 and 9,000 feet; 10 to 15 inches between 4,000 and 5,000 feet; and in the lower basin, below an elevation of 4,000 feet, from 15 to 20 inches annually.

The winters are very severe, especially above the points where the mountain streams emerge into the more open country. In the mountain sections the snowfall is heavy, and snowstorms are common on the plains areas, but here the snow usually disappears within a few days after each storm. During the winter months the river and its tributaries are frequently frozen over throughout their entire courses. The ice period varies from about two months in the vicinity of Julesburg, Colo., to about five months in the high mountains, where the streams are frozen almost to the bottom. (See Pl. XII.)

The South Platte basin contains the oldest cultivated and irrigated areas in Colorado. At present nearly 1,000,000 acres are under irrigation in Colorado from the South Platte and its tributaries. In fact, the entire normal flow is being used for this purpose, and additional irrigation will necessitate the construction of storage reservoirs or the diversion of water from other drainage areas. The North Grand ditch, which has been in operation for several years, diverts water from the North Fork of Grand River across the divide into Cache la Poudre River. The Laramie-Poudre project, which will soon be begun, contemplates the diversion of the headwaters of Laramie River in the watershed of the North Platte, into the Cache la Poudre, in the watershed of the South Platte; and the Denver Reservoir and Irrigation Company proposes to divert the headwaters of Fraser River, a tributary of the Grand, into the headwaters of South Boulder, a tributary of the South Platte. Other similar

projects are under consideration. The storage of the flood waters of the intermittent streams in the lower basin offer opportunities for considerable irrigation development. Very little is known as to the flow of these streams, but it is certainly very large at times and many excellent storage sites are available.

About a half million acre-feet of the annual flow from the mountain section of this basin are now being stored for irrigation in many small reservoirs, and a large part of the mountain flow is still available for irrigation by proper conservation and storage.

Conditions on the upper South Platte and its tributaries are unusually favorable for storage (Pl. XII, *A*). Some of the many good sites are natural depressions or are situated on small tributaries, so that the reservoirs will have to be supplied by feeder canals. Of this type is the Standley reservoir of the Denver Reservoir and Irrigation Company. This reservoir, which is now under construction, will have a maximum capacity of about 100,000 acre-feet.

The largest reservoir which has been constructed in the South Platte basin is the Cheesman Lake of the Denver Union Water Company. This reservoir, which was completed in 1904, has a maximum capacity of 79,000 acre-feet. Among other proposed reservoirs may be mentioned the Antero, Tarryall, Lake George, Lost Park, Eagle Rock, and Geneva. Opportunities for storage are also found on Clear Creek, Boulder, St. Vrain, Big Thompson, and the Cache la Poudre. Some excellent reservoir sites have been surveyed on the last-named stream, and no doubt will be developed shortly. The reservoirs on the upper portions of these streams will be used primarily for power development, but the stored waters can also be used for irrigation in the valleys below.

Water-power development is necessarily limited to the mountainous parts of the drainage area. Many favorable opportunities for such development are presented on Geneva Creek, the South Fork, Clear Creek, Boulder Creek, Big Thompson, and Cache la Poudre. Many power sites have been filed upon. The ultimate power development in this drainage basin will probably amount to nearly 200,000 horsepower, but present development is limited to numerous small plants with a total capacity of less than 5,000 horsepower. Most of these plants are on Clear Creek and Boulder Creek. The plant of the Eastern Colorado Power Company, on Boulder Creek, a few miles above Boulder, Colo., is now under construction, and when completed will have a capacity of probably 20,000 horsepower.

Of the years for which Survey records are available, 1902 seems to be the driest and 1907 the wettest. It is believed, however, that the flow of the streams in 1899 was considerably higher than in 1907, and that in 1900 was quite high in some parts of the basin.

A. PORTION OF ELKHORN RESERVOIR SITE ON CACHE LA POUDRE RIVER.

Capacity will be 113,757 acre-feet with a dam 400 feet high Mouth of Elkhorn Creek in foreground.

B. CONTINENTAL DIVIDE NEAR TOLLAND, COLO.

The following gaging stations have been maintained in this drainage basin:

South Fork of South Platte River near Cheesman Lake, Colo., 1899–1901.
South Fork of South Platte River at South Platte, Colo., 1905–1908.
South Platte River at South Platte, Colo., 1902–1908.
South Platte River near Deansbury (Platte Canyon), Colo., 1887–1892, 1895–1900.
South Platte River at Denver, Colo., 1895–1906.
South Platte River near Kersey, Colo., 1901–1903, 1905–1908.
South Platte River near Orchard, Colo., 1895–1900.
South Platte River near Julesburg, Colo., 1902–1906, 1908.
South Platte River near Big Spring, Nebr., 1902–3.
Goose Creek near Cheesman Lake, Colo., 1899.
North Fork of South Platte River at Cassells, Colo., 1908.
Geneva Creek near Grant, Colo., 1908.
Bear Creek near Morrison, Colo., 1888–1891, 1895–1902.
Clear Creek at Forkscreek, Colo., 1899–1908.
Clear Creek at Golden, Colo., 1897–1898.
St. Vrain Creek near Lyons, Colo., 1888–1892, 1895–1903.
Boulder Creek at Orodell, Colo., 1907–8.
Boulder Creek near Boulder, Colo., 1888–1892, 1895–1901, 1907–8.
North Boulder Creek near Boulder, Colo., 1887–1890.
South Boulder Creek near Marshall, Colo., 1888–1892, 1895–1901.
Big Thompson Creek near Arkins, Colo., 1888–1890, 1895–1903.
Handy Ditch near Arkins, Colo., 1903.
Cache la Poudre River near Fort Collins, Colo., 1884–1901.
Cache la Poudre River near Greeley, Colo., 1903.
Middle Crow Creek near Hecla, Wyo., 1902–3.

SOUTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established May 8, 1905, to determine the run-off in this basin and the amount of water available on this branch of the South Platte for power and irrigation, is located at South Platte, Colo., in T. 7 S., R. 70 W.

The North and South forks of the South Platte unite about 500 feet below the station, and the Cheesman reservoir, which intercepts the flow of Tarryall and Goose creeks in addition to that of the main branch, is about 20 miles above. No very important tributaries enter below Cheesman Lake. The drainage area above the station is 2,160 square miles, of which probably less than 20 per cent can be classed as timbered land.

No water is diverted above this point except for the irrigation of hay lands in South Park, but the flow is regulated by the Cheesman reservoir, which has a capacity of 79,000 acre-feet. So many filings for power development have been made on this stream that it is doubtful whether additional filings can be made except near the headwaters.

The flow of the river at this station is affected by ice for about three months in the winter season.

No change has been made in the gage since it was first established, and the datum remains the same.

Fair results should be obtained at this station, but as the bed is shifting frequent measurements are necessary. The gage heights are apt to show fluctuation at certain times of the year owing to storage or release of water in the Cheesman reservoir.

Discharge measurements of South Fork of South Platte River at South Platte, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	C. L. Chatfield	34	29	1.20	72
March 11	do	58	49	1.80	138
April 10	do	57	62	1.85	171
Do	do	57	61	1.85	142
May 9	do	61	128	2.88	486
May 28	do	58	85	2.15	251
June 6	do	60	103	2.45	322
June 28	do	63	163	3.45	620
August 8	W. B. Freeman	61	110	2.63	479
August 27	C. L. Chatfield	63	96	2.35	315
October 12	J. B. Stewart	58	51	1.61	149
November 9	do	56	47	1.53	137
December 10	do	48	32	.98	59
1908.					
January 17 [a]	J. B. Stewart	22	32	1.00	27
February 21 [a]	do	35	28	1.08	28
Do. [a b]	do	24	17	1.18	31
March 19	do	62	83	2.10	186
May 11	W. B. Freeman	52.5	47	1.58	129
June 6	Freeman and Stewart	42	36	1.26	74
July 3 [b]	J. B. Stewart	50	60	1.80	153
September 3	do	54	57	1.68	144
October 28	do	48	41	1.20	71
December 17 [a b]	W. B. Freeman	22	16.2	1.32	20.6

[a] Ice conditions. [b] Made by wading.

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908.

[Miss E. H. Jardine, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1		1.65	1.52	2.02	2.88	3.42	3.58	2.40	1.80	1.55	1.15
2		1.65	1.60	2.12	3.02	3.58	3.52	2.40	1.80	1.55	1.02
3		1.65	1.70	2.20	2.92	3.55	3.45	2.40	1.40	1.70	1.10
4		1.60	1.90	2.28	2.80	3.85	3.35	2.30	1.50	1.60	1.05
5		1.62	2.15	2.20	2.60	3.70	3.10	2.30	1.50	1.55	1.00
6		1.70	2.00	2.28	2.48	3.60	3.95	2.30	1.50	1.55	1.20
7		1.62	2.00	2.40	2.48	3.55	2.75	2.30	1.60	1.60	1.18
8		1.70	1.95	2.68	2.45	3.60	2.65	2.25	1.80	1.55	1.10
9		1.72	1.90	2.85	2.42	3.40	2.50	2.00	1.62	1.55	1.02
10		1.75	1.88	2.80	2.40	3.45	2.50	1.92	1.60	1.50	1.00
11		1.68	1.98	2.80	2.45	3.50	2.50	1.88	1.60	1.42	1.15
12	1.20	1.70	2.22	2.72	2.50	3.48	2.40	1.75	1.60	1.40	.98
13	1.30	1.70	2.15	2.70	2.45	3.25	2.40	1.75	1.60	1.30	1.05
14	1.30	1.65	2.10	2.55	2.70	3.00	2.40	1.75	1.60	1.30	.85
15	1.35	1.50	2.10	2.50	2.80	3.30	2.45	1.75	1.60	1.30	.92
16	1.30	1.48	2.05	2.50	3.25	3.30	2.50	1.78	1.60	1.30	1.10
17	1.35	1.50	2.05	2.50	3.45	3.08	2.45	1.82	1.60	1.30	1.50
18	1.40	1.70	2.00	2.50	3.50	2.65	2.38	1.82	1.60	1.25	1.72
19	1.40	1.80	2.00	2.40	3.70	2.52	2.35	2.00	1.50	1.20	1.78
20	1.40	2.08	2.00	2.40	3.95	2.35	2.45	2.10	1.50	1.30	1.82

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
21	1.45	2.10	1.85	2.40	4.20	2.28	2.55	2.10	1.50	1.30	1.82
22	1.45	2.30	1.85	2.45	4.10	2.28	2.60	2.10	1.50	1.30	1.82
23	1.50	2.25	1.95	2.50	3.88	2.30	2.52	2.08	1.50	1.30	1.52
24	1.60	2.20	1.98	2.45	3.60	2.70	2.40	2.00	1.52	1.30	1.42
25	1.60	2.00	2.15	2.45	3.50	2.85	2.40	2.00	1.58	1.30	1.42
26	1.62	2.00	2.28	2.40	3.50	3.10	2.38	2.05	1.50	1.15	1.42
27	1.65	1.80	2.25	2.35	3.58	3.78	2.38	2.05	1.60	1.18	1.15
28	1.65	1.80	2.25	2.20	3.55	4.55	2.50	2.00	1.65	1.12	1.10
29	.....	1.78	2.20	2.22	3.48	4.90	2.42	1.92	1.70	1.05	1.98
30	.....	1.60	2.12	2.50	3.42	4.42	2.38	1.80	1.80	1.15	1.10
31	.....	1.60	.....	2.75	.....	3.85	2.42	.....	1.65	.....	1.08
1908.											
1	.....	.....	1.5	1.5	1.2	1.75	2.0	2.0	1.6	1.2	1.4
2	.....	.....	1.5	1.5	1.9	1.8	2.4	1.8	1.55	1.2	1.4
3	.....	.....	1.5	1.5	1.5	1.8	2.35	1.7	1.55	1.2	1.4
4	.....	.....	1.5	1.55	1.35	1.65	2.35	1.65	1.5	.8	1.3
5	.....	.....	1.5	1.5	1.3	1.65	2.5	1.5	1.5	.7	1.3
6	.....	.....	1.55	1.4	1.25	1.65	2.6	1.5	1.5	.7	1.2
7	.....	.....	1.6	1.5	1.3	1.65	2.35	1.5	1.4	.7	1.0
8	.....	1.0	1.6	1.6	1.3	1.65	2.3	1.5	1.35	.7	1.15
9	.....	.9	1.6	1.7	1.3	1.6	2.3	1.45	1.35	.7	1.2
10	.....	.9	1.6	1.65	1.3	1.6	2.3	1.4	1.35	.7	1.45
11	.....	.9	1.6	1.6	1.9	1.85	2.3	1.35	1.3	.7	1.45
12	.....	.9	1.6	1.5	1.9	2.25	2.0	1.4	1.25	.7	1.55
13	.....	.95	1.6	1.4	1.9	1.6	2.0	1.5	1.25	.6	1.2
14	.....	.95	1.6	1.35	1.9	1.75	2.0	1.5	1.3	.95	1.3
15	.....	.95	1.65	1.3	1.9	1.9	2.0	2.0	1.25	.9	1.3
16	.....	.95	1.7	1.3	1.9	1.9	2.1	2.0	1.25	1.1	1.45
17	.....	1.2	1.7	1.2	1.9	1.9	2.25	2.0	1.25	1.2	1.3
18	.....	1.9	1.75	1.25	1.9	1.9	2.3	2.0	1.3	1.0	1.4
19	.....	2.1	1.8	1.3	1.8	2.1	2.3	2.0	1.3	.9	1.4
20	.....	2.1	1.8	1.35	1.8	2.05	2.3	1.9	1.35	.9	1.5
21	.....	2.05	1.7	1.4	1.5	2.0	2.5	1.8	1.4	.8	2.0
22	.....	2.05	1.7	1.45	1.5	2.0	2.7	1.8	1.4	.7	2.0
23	.....	1.9	1.7	1.3	1.45	2.0	2.6	1.8	1.3	.7	2.0
24	.....	1.8	1.6	1.3	1.4	1.95	2.55	1.8	1.25	.65	1.8
25	.....	1.7	1.55	1.3	1.4	2.0	2.45	1.6	1.3	.7	1.4
26	.....	1.7	1.5	1.3	1.4	2.0	2.4	1.7	1.3	.75	1.8
27	.....	1.7	1.5	1.3	1.4	2.0	2.35	1.7	1.2	.8	1.8
28	.....	1.7	1.5	1.25	1.55	1.9	1.7	1.7	1.2	1.05	1.8
29	.....	1.6	1.5	1.2	1.75	1.8	1.7	1.7	1.45	1.0	1.8
30	.....	1.6	1.5	1.3	1.75	1.8	2.05	1.6	1.35	1.15	1.75
31	.....	1.5	.....	1.3	.....	1.9	2.0	.....	1.2	.....	1.9

NOTE.—Ice conditions January 1 to about February 12, 1907, December 15, 1907, to March 7, 1908, and after November 13, 1908. Water standing in pools November 4–13, 1908.

Rating tables for South Fork of South Platte River at South Platte, Colo.

FEBRUARY 12 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	55	1.90	165	2.80	455	3.70	980
1.10	63	2.00	190	2.90	505	3.80	1,045
1.20	72	2.10	215	3.00	560	3.90	1,110
1.30	82	2.20	240	3.10	615	4.00	1,175
1.40	92	2.30	270	3.20	670	4.20	1,310
1.50	102	2.40	300	3.30	730	4.40	1,450
1.60	113	2.50	335	3.40	790	4.60	1,590
1.70	127	2.60	370	3.50	850	4.80	1,730
1.80	145	2.70	410	3.60	915	5.00	1,870

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the above period and on the form of the 1906 curve. It is well defined above gage height 1.2 feet. Above gage height 1.8 feet it is the same as the 1906 table.

Rating tables for South Fork of South Platte River at South Platte, Colo.—Continued.

AUGUST 1 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.,*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	50	1.70	170	2.50	410	3.30	770
1.00	60	1.80	190	2.60	450	3.40	820
1.10	70	1.90	215	2.70	495	3.50	870
1.20	85	2.00	240	2.80	540	3.60	925
1.30	100	2.10	265	2.90	585	3.70	980
1.40	115	2.20	295	3.00	630		
1.50	130	2.30	330	3.10	675		
1.60	150	2.40	370	3.20	720		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and the form of previous curves. It is well defined.

MARCH 8 TO MARCH 30, 1908.

0.90	35	1.30	61	1.70	112	2.10	186
1.00	40	1.40	72	1.80	128		
1.10	45	1.50	84	1.90	147		
1.20	52	1.60	98	2.00	166		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during the above period and the form of preceding curves. It is not well defined.

MARCH 31 TO APRIL 25, 1908.

[Indirect method for shifting channels used.]

APRIL 26 TO NOVEMBER 3, 1908.

1.20	71	1.60	126	2.00	200	2.40	303
1.30	80	1.70	144	2.10	222	2.50	335
1.40	94	1.80	162	2.20	247	2.60	370
1.50	110	1.90	181	2.30	274	2.70	410

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and the form of preceding curves, and is well defined between gage heights 1.2 feet and 1.9 feet

Daily discharge, in second-feet, of South Fork of South Platte River at South Platte, Colo., for 1908.

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1		86	11		110	21		135
2		89	12		112	22		130
3		93	13		115	23		125
4		96	14		120	24		120
5		98	15		125	25		115
6		100	16		133	26		
7		102	17		140	27		
8		104	18		145	28		
9		106	19		150	29		
10		108	20		155	30		
						31	84	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy
	Maximum.	Minimum.	Mean.		
1907.					
February 12–28	120	72	96.8	3,260	C.
March	270	100	146	8,980	A.
April	264	104	194	11,500	A.
May	480	195	325	20,000	A.
June	1,310	300	667	39,700	A.
July	1,800	264	782	48,100	A.
August	914	350	472	29,000	B.
September	370	180	255	15,200	A.
October	190	115	149	9,160	A.
November	170	65	111	6,600	A.
December	85	35	53.3	3,280	C.
The period				195,000	
1908.					
January			30	1,840	D.
February			30	1,730	D.
March	186	35	80.7	4,960	C.
April	155	86	115	6,840	B.
May	144	71	95.5	5,870	B.
June	181	71	127	7,560	A.
July	260	126	173	10,600	A.
August	410	144	269	16,500	A.
September	200	87	144	8,570	A.
October	126	71	88.4	5,440	A.
November	71	0	29.9	1,780	D.
December			23.4	1,440	D.
The year	410	0	100	73,100	

NOTE.—Discharge estimated December 16, 1907, to March 7, 1908, and November 14 to December 31, 1908. No flow November 4–13, 1908.

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established March 28, 1902, furnishes valuable data for use in connection with storage, irrigation, and water-power development. It is located on the Colorado and Southern Railroad in T. 7 S., R. 7 W., about 9 miles above the mouth of the canyon and just below the junction of the North and South forks. Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of the years 1893 and 1894, and records at Platte Canyon are still being taken by the Denver Union Water Company. The earlier records, 1887–1892, were taken by the state engineer, and the records from 1895 to 1898 were taken under the direction of the Denver Power and Irrigation Company.

The station is especially important because of its location above the head-gates of all irrigation systems and also above the intake of the Denver Union Water Company. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the proposed installation of several power plants on both forks of the river above add to the importance of the station.

A great many filings for power development have been made on the tributaries of the river above this point, but doubtless opportunities for additional filings still exist.

The flow of the South Fork of the South Platte is regulated by storage in Cheesman reservoir. The flow of the North Fork is natural, except for slight variations due to the many ice and fish ponds for 30 miles above its mouth.

The river and its tributaries are usually frozen over from two to four months during the winter time.

On May 7, 1905, the gage was moved from the county bridge to a point 150 feet downstream, which no doubt caused some change in the relation of gage readings.

The stream bed is more or less shifting, and frequent discharge measurements are necessary to obtain the best results. The gage readings taken twice each day are apt to show considerable fluctuation owing to the regulation of the flow from the Cheesman reservoir.

Discharge measurements of South Platte River at South Platte, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	C. L. Chatfield	73	65	1.70	129
March 11	do	75	90	2.00	211
April 10	do	75	100	2.18	258
Do	do	75	103	2.20	263
May 9	do	78	202	3.15	665
May 28	do	79	187	2.85	618
June 6	do	78	242	3.45	952
June 28	do	79	285	4.12	1,200
August 8	W. B. Freeman	76	196	3.11	751
August 27	C. L. Chatfield	78	165	2.72	510
October 12	J. B. Stewart	77	102	2.10	223
November 9	do	75	83	2.05	196
December 10[a]	do	74	62	1.70	84
1908.					
January 17[a]	J. B. Stewart	39	44	1.74	80
February 21[a]	do	36.5	45	1.45	93
March 19	do	77	111	2.30	232
May 11	W. B. Freeman	74	83	2.10	190
June 6	J. B. Stewart	76	90	2.08	207
July 3	do	76	102	2.15	236
September 3	do	75	97	2.20	232
October 28	do	75	76	1.80	145
December 17[a]	W. B. Freeman	23	38	1.55	59

[a] Ice conditions.

Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1907 and 1908.

[E. H. Jardine, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	1.95	2.02	2.30	3.40	4.05	4.00	2.80	2.25	2.02	1.68
2	.....	1.98	2.00	2.45	3.50	4.18	4.05	2.80	2.28	2.00	1.62
3	.....	1.95	2.00	2.42	3.45	4.22	3.88	2.80	2.00	2.10	1.72
4	.....	1.90	2.20	2.55	3.32	4.20	3.75	2.60	2.00	2.05	1.75
5	.....	1.92	2.35	2.50	3.30	4.20	3.70	2.60	2.10	2.00	1.72
6	.....	1.98	2.30	2.50	3.50	4.02	3.40	2.60	2.10	2.00	1.75
7	.....	1.92	2.20	2.70	3.40	4.05	3.22	2.65	2.10	2.00	1.75
8	.....	1.92	2.20	2.90	3.40	4.10	3.12	2.55	2.30	2.08	1.75
9	.....	1.95	2.20	3.15	3.35	3.85	3.10	2.40	2.20	2.05	1.72
10	.....	1.98	2.18	3.12	3.25	4.00	3.00	2.40	2.15	2.00	1.68
11	.....	1.98	2.30	3.10	3.25	4.00	3.00	2.35	2.20	1.90	1.65
12	1.70	1.92	2.42	3.15	3.55	3.90	2.90	2.30	2.10	1.95	1.72
13	1.65	1.90	2.45	3.12	3.60	3.70	2.90	2.25	2.10	1.80	1.68
14	1.65	1.90	2.40	2.95	3.70	3.62	2.90	2.25	2.10	1.70	1.75
15	1.65	1.82	2.40	2.90	3.78	3.70	3.00	2.25	2.10	1.70	1.72
16	1.65	1.88	2.38	2.90	3.95	3.70	2.90	2.22	2.10	1.70	1.82
17	1.70	1.95	2.32	2.90	3.90	3.40	2.85	2.25	2.10	1.70	2.00
18	1.75	2.00	2.30	2.90	3.95	3.65	2.80	2.22	2.00	1.65	2.35
19	1.75	2.00	2.30	3.20	4.22	2.90	2.70	2.35	2.00	1.62	2.55
20	1.75	2.18	2.20	3.12	4.32	2.90	2.80	2.40	2.00	1.70	2.78
21	1.80	2.30	2.10	3.40	4.52	2.85	2.85	2.40	2.00	1.70	2.55
22	1.82	2.38	2.22	3.40	4.40	2.85	2.90	2.40	2.00	1.70	2.55
23	1.85	2.30	2.32	3.30	4.32	2.90	2.82	2.40	2.00	1.70	2.42
24	2.00	2.38	2.38	3.20	4.30	3.10	2.75	2.35	2.05	1.70	2.40
25	1.95	2.30	2.40	3.10	4.05	3.20	2.68	2.32	2.10	1.70	2.42
26	1.95	2.50	2.48	3.08	4.00	3.65	2.70	2.40	2.02	1.78	2.40
27	1.95	2.20	2.45	2.95	4.15	3.80	2.80	2.40	2.10	1.72	2.32
28	1.95	2.10	2.40	2.90	4.08	4.78	2.88	2.30	2.15	1.70	2.02
29	.....	2.05	2.40	2.90	4.05	5.10	2.80	2.25	2.15	1.78	2.48
30	.....	2.00	2.40	3.08	4.00	4.48	2.80	2.30	2.15	1.72	2.60
31	.....	2.00	.....	3.20	.....	4.12	2.80	.....	2.00	.....	2.50
1908.											
1	.....	.....	2.0	1.95	2.0	2.2	2.4	2.35	2.0	1.8	1.7
2	.....	.....	2.0	1.95	2.35	2.2	2.65	2.35	2.0	1.8	1.8
3	.....	.....	1.95	1.95	2.3	2.2	2.6	2.25	2.0	1.8	1.75
4	.....	.....	2.0	2.1	2.1	2.1	2.5	2.2	2.05	1.6	1.85
5	.....	.....	2.0	2.05	2.1	2.1	2.6	2.1	2.0	1.55	1.8
6	.....	.....	2.0	1.95	2.1	2.1	3.2	2.0	2.0	1.55	1.6
7	.....	.....	2.0	2.1	2.0	2.1	2.6	1.95	2.0	1.55	1.65
8	.....	1.5	2.0	2.2	2.0	2.05	2.5	1.9	2.0	1.5	1.6
9	.....	1.4	2.0	2.3	2.0	2.0	2.5	2.1	2.0	1.5	1.7
10	.....	1.5	2.05	2.2	2.0	2.05	2.5	2.0	2.0	1.5	1.7
11	.....	1.4	2.05	2.1	2.5	2.25	2.5	2.0	1.9	1.5	1.75
12	.....	1.45	2.05	2.0	2.4	2.6	2.4	2.1	2.0	1.5	1.7
13	.....	1.5	2.1	1.95	2.4	2.4	2.3	2.2	1.8	1.45	1.65
14	.....	1.5	2.1	1.95	2.4	2.4	2.3	2.2	1.85	1.5	1.55
15	.....	1.5	2.15	1.9	2.5	2.35	2.3	2.5	1.9	1.8	1.55
16	.....	1.5	2.15	1.9	2.4	2.35	2.4	2.4	1.9	1.8	1.65
17	.....	1.7	2.2	1.9	2.4	2.35	2.5	2.3	1.9	2.0	1.6
18	.....	2.2	2.25	1.95	2.4	2.35	2.6	2.3	1.9	2.1	1.7
19	.....	2.3	2.3	2.0	2.4	2.45	2.65	2.3	1.9	1.95	1.75
20	.....	2.3	2.2	2.15	2.3	2.3	2.7	2.3	1.9	1.8	1.8
21	.....	2.25	2.15	2.2	2.2	2.3	2.85	2.2	1.9	1.8	2.0
22	.....	2.2	2.15	2.2	2.1	2.3	2.9	2.2	2.0	1.7	2.1
23	.....	2.1	2.1	2.1	2.1	2.3	2.8	2.2	2.0	1.7	2.1
24	.....	2.1	2.1	2.2	2.1	2.35	2.8	2.2	2.0	1.65	2.0
25	.....	2.1	2.05	2.2	2.05	2.35	2.75	2.1	1.9	1.7	1.5
26	.....	2.1	2.0	2.1	2.05	2.3	2.75	2.2	1.8	1.7	1.7
27	.....	2.1	1.95	2.1	2.05	2.3	2.7	2.2	1.8	1.7	1.7
28	.....	2.1	1.95	2.0	2.2	2.2	2.35	2.2	1.9	1.65	1.7
29	.....	2.0	1.95	2.0	2.2	2.2	2.3	2.2	2.0	1.7	1.75
30	.....	2.0	1.95	2.0	2.2	2.2	2.4	2.1	1.9	1.7	1.7
31	.....	2.0	.....	2.0	.....	2.45	2.4	.....	1.8	.....	1.85

NOTE.—Ice conditions January 1 to February 12, 1907, November 25, 1907, to March 7, 1908, and after November 14, 1908.

Rating tables for South Platte River at South Platte, Colo.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	105	2.50	385	3.40	920	4.30	1,550
1.70	125	2.60	435	3.50	990	4.40	1,625
1.80	145	2.70	490	3.60	1,060	4.50	1,700
1.90	170	2.80	545	3.70	1,130	4.60	1,775
2.00	200	2.90	600	3.80	1,200	4.70	1,850
2.10	230	3.00	660	3.90	1,270	4.80	1,930
2.20	265	3.10	720	4.00	1,340	4.90	2,010
2.30	300	3.20	785	4.10	1,410	5.00	2,090
2.40	340	3.30	850	4.20	1,480	5.20	2,250

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on thirteen discharge measurements made during 1907 and on earlier high-water measurements. It is well defined between gage heights 1.7 feet and 3.5 feet. Above gage height 3.9 feet it is the same as the 1905 table.

MARCH 8 TO NOVEMBER 14, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	155	152	180	255	315	285	188	145
2	.....	155	152	295	255	428	285	188	145
3	.....	145	152	280	255	405	250	188	145
4	.....	155	190	210	220	360	232	215	105
5	.....	155	175	210	220	405	202	188	94
6	.....	155	152	210	220	740	175	188	94
7	.....	155	190	182	220	405	162	188	94
8	75	155	220	182	208	360	150	188	88
9	63	155	250	182	194	360	202	188	88
10	75	168	220	182	208	360	175	188	88
11	55	168	190	360	275	360	175	162	88
12	62	168	165	320	420	315	202	188	88
13	68	180	152	320	335	280	240	140	80
14	68	180	152	320	335	280	240	150	88
15	68	195	140	360	312	280	350	162	.....
16	68	195	140	320	312	315	312	162	.....
17	90	210	140	320	312	360	275	162	.....
18	200	225	160	320	312	405	275	162	.....
19	230	240	172	320	335	410	275	168	.....
20	230	210	215	280	280	435	275	168	.....
21	215	195	230	255	280	510	240	168	.....
22	200	195	230	220	280	540	240	194	.....
23	172	180	200	220	280	485	240	194	.....
24	172	180	230	220	295	485	240	194	.....
25	172	168	230	208	295	460	210	168	.....
26	172	155	200	208	280	460	240	140	.....
27	172	145	200	208	280	435	240	140	.....
28	172	152	172	255	245	285	240	168	.....
29	150	152	172	255	245	265	240	200	.....
30	150	152	172	255	245	305	210	172	.....
31	150	.....	172	.....	335	305	.....	145	.....

NOTE.—The discharges were obtained by the indirect method for shifting channels.

Monthly discharge of South Platte River at South Platte, Colo., for 1907 and 1908.

[Drainage area, 2,610 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 12–28	200	115	148	0.057	0.04	4,990	B.
March	385	150	218	.084	.10	13,400	A.
April	376	200	299	.115	.13	17,800	A.
May	920	300	637	.244	.28	39,200	B.
June	1,720	818	1,200	.460	.51	71,400	B.
July	2,170	572	1,190	.456	.53	73,200	B.
August	1,380	479	708	.271	.31	43,500	A.
September	545	272	355	.136	.15	21,100	A.
October	300	200	231	.089	.10	14,200	A.
November	230	91	153	.059	.07	9,100	B.
December	84	80	82.3	.032	.04	5,060	D.
The period						313,000	
1908.							
January			80	.031	.04	4,920	D.
February			90	.034	.04	5,180	D.
March	230	55	123	.047	.05	7,560	C.
April	240	145	173	.066	.07	10,300	B.
May	250	140	183	.070	.08	11,300	B.
June	360	180	255	.098	.11	15,200	B.
July	420	194	276	.106	.12	17,000	B.
August	740	265	391	.150	.17	24,000	B.
September	350	150	236	.090	.10	14,000	B.
October	215	140	175	.067	.08	10,800	B.
November	145	75	91.2	.035	.04	5,430	C.
December	105	60	71.3	.027	.03	4,380	D.
The year			179	.068	.93	130,000	

NOTE.—Discharge estimated November 25, 1907, to March 7, 1908, and November 15 to December 31, 1908, the probable frozen periods.

SOUTH PLATTE RIVER NEAR KERSEY, COLO.

This station, which was established April 27, 1901, is located at a pile bridge about 1½ miles north of Kersey on the Union Pacific Railroad about 6 miles east of Greeley in T. 5 N., R. 64 W. The station was discontinued during the fall of 1903, but was reestablished March 5, 1905.

The station is below all the important tributaries of the South Platte that derive their supply from the mountain region, and the records are therefore particularly important as showing the amount of water available for storage reservoirs in northeastern Colorado.

Cache la Poudre River, a very important tributary of the South Platte, enters 2 or 3 miles above the station. Crow Creek and Box-elder Creek, two intermittent streams, come in from the north and south sides, 4 or 5 miles below. The drainage area at Kersey is 9,500 square miles.

Above Kersey are numerous irrigation and canal systems serving one of the most extensively irrigated areas in Colorado. Nearly 790,000 acres were irrigated above this station in 1907, about 380,000 acre-feet of water were stored, and about half of it used during the

season. In 1908 about 300,000 acre-feet were stored, all of which was used for irrigation.

No important water-power plants are operated on the South Platte or its tributaries above the station, but one or two are now under construction and several are contemplated. In order to secure additional water rights for irrigation it will be necessary to construct storage works on some of the tributaries, as filings greatly in excess of the natural flow of the stream have been on record for a number of years.

The river is generally frozen over from the middle of December to the first of March.

In the fall of 1906 a chain gage was established on each of the two channels into which the river is divided at ordinary stages. Formerly one rod gage was used, but it was found that the elevation of the water surface in the two channels differed considerably. Owing to the shifting character of the stream bed, a slight change in the datum of the gage is not apt to seriously affect the value of the results, as marked changes occur in the rating curve from one season to the next and often during a single season.

Measurements should be taken at this station on an average of at least once every three weeks, except when the river is at a constant stage. Accurate results are rather difficult to obtain on account of the piles of the bridge and the fact that the bridge is not at right angles to the direction of the current. Whenever possible measurements should be taken by wading. At high stages the river flows in three channels and during extreme floods overflows into one or two channels on the left bank.

Discharge measurements of South Platte River near Kersey, Colo. (gage No. 1), in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	R. I. Meeker	110	118	2.97	244
March 29	C. L. Chatfield	103	98	2.50	185
April 8	do	105	103	2.60	195
May 31	W. B. Freeman	114	218	3.82	619
June 19	do	116	223	3.76	545
July 2	C. L. Chatfield	168	496	5.88	1,450
July 28	W. B. Freeman	159	453	5.56	1,680
August 20	do	63	55	2.33	93
October 12	do	96	129	3.12	287
October 22	J. B. Stewart	92	119	2.95	214
December 18[a]	do	60	99	2.90	246
1908.					
March 13	J. B. Stewart	72	88	2.69	163
May 13	W. B. Freeman	32	22.7	1.85	35.4
June 11[b]	do	26	25.2	1.79	44.0
July 22[b]	J. B. Stewart	31.5	37.1	1.98	55.0
August 29[b]	do	30.5	31	1.85	54.0
November 3	do	41	60	2.60	133

[a] Slush ice and ice around piles and on the edges.

[b] Made by wading.

Daily gage height, in feet, of South Platte River near Kersey, Colo. (gage No. 1), for 1907 and 1908.

[C. A. Maisner and Mrs. J. C. Maisner, observers.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	2.90	.....	3.12	4.50	5.58	5.22	2.52	3.12	3.00	3.05
2	.....	2.90	.....	3.15	4.45	5.75	4.92	2.45	3.28	3.00	3.05
3	.....	2.85	.....	3.18	4.50	5.58	4.78	2.45	3.30	3.02	3.05
4	.....	2.85	.....	3.20	4.80	5.32	4.62	2.40	3.28	3.05	3.05
5	.....	2.80	.....	3.30	4.45	5.05	4.55	2.35	3.25	3.05	3.05
6	.....	2.80	.....	3.42	4.30	5.12	4.30	2.32	3.20	3.05	3.05
7	.....	2.75	.....	3.68	4.55	4.78	4.00	2.42	3.15	3.05	3.05
8	.....	2.75	2.60	3.85	4.62	4.40	3.60	2.40	3.15	3.08	3.05
9	.....	2.75	2.45	3.88	4.42	4.20	3.30	2.48	3.15	3.10	3.05
10	.....	2.70	2.35	3.88	4.50	3.75	3.15	2.65	3.15	3.15	3.05
11	.....	2.70	2.22	3.85	3.85	3.78	2.92	2.55	3.15	3.15	3.05
12	.....	2.70	2.30	3.80	3.15	3.65	2.85	2.52	3.15	3.15	3.00
13	3.00	2.70	2.00	3.92	3.20	3.35	2.65	2.50	3.08	3.20	3.05
14	3.00	2.65	1.92	4.28	3.20	3.35	2.50	2.45	3.05	3.20	3.10
15	3.00	2.65	1.78	4.58	3.70	3.20	2.48	2.50	3.05	3.15	3.02
16	3.00	2.60	1.70	4.55	4.10	3.12	2.40	2.52	2.95	3.15	3.00
17	3.00	2.60	1.70	4.35	4.40	2.80	2.38	2.55	2.95	3.15	3.00
18	3.00	2.60	1.65	4.18	3.85	2.58	2.35	2.58	2.90	3.15	2.92
19	2.95	2.60	1.60	3.98	3.65	2.45	2.38	2.60	2.90	3.15	2.90
20	2.90	2.55	2.00	4.02	3.85	2.38	2.43	2.60	2.92	3.15	2.95
21	2.85	2.55	2.62	4.25	3.70	2.22	2.40	2.65	2.95	3.15	2.90
22	2.85	2.55	2.92	4.25	3.70	2.22	2.30	2.65	2.95	3.15	2.90
23	2.85	2.55	2.50	4.32	3.75	2.28	2.30	2.68	2.92	3.10	2.98
24	2.85	2.55	3.00	4.15	4.15	2.20	2.30	2.70	2.92	3.05	2.98
25	2.90	2.55	2.90	4.38	4.20	2.20	2.28	2.75	2.98	3.05	3.05
26	2.90	2.55	2.82	4.38	4.82	2.25	2.30	2.75	3.00	3.05	3.08
27	2.90	2.55	2.78	3.98	5.50	4.60	2.30	2.80	3.00	3.05	3.05
28	2.90	2.55	2.75	3.50	5.60	5.48	2.30	2.80	3.05	3.05	3.10
29	.....	2.5	3.20	3.22	5.58	5.52	2.30	2.88	3.05	3.05	3.10
30	.....	2.5	3.12	3.18	5.38	5.62	2.48	3.00	3.05	3.05	3.00
31	.....	2.5	.....	3.60	.....	5.52	2.75	.....	3.05	.....	2.90
1908.											
1	.....	.....	2.15	1.7	2.0	1.8	2.3	1.8	2.15	2.7	.....
2	.....	.....	2.15	1.7	1.9	1.8	1.95	1.8	2.2	2.6	.....
3	.....	.....	2.15	1.7	1.9	1.8	1.9	1.85	2.2	2.6	.....
4	.....	.....	2.1	.....	1.9	1.8	1.8	1.85	2.2	2.6	.....
5	.....	.....	2.1	2.0	1.85	1.8	1.8	1.85	2.2	2.6	.....
6	.....	.....	.....	2.2	1.85	1.8	1.8	1.85	2.3	2.6	.....
7	.....	.....	.....	2.2	1.85	1.8	1.85	1.85	2.3	2.55	.....
8	.....	.....	.....	2.4	1.8	1.8	2.0	1.9	2.3	2.5	.....
9	.....	.....	2.1	2.2	1.8	1.8	1.95	1.9	2.3	2.5	.....
10	.....	2.7	2.5	1.9	1.8	1.8	2.0	1.9	2.3	2.5	.....
11	.....	2.7	1.95	1.85	1.8	1.8	2.0	1.9	2.3	2.5	.....
12	.....	2.7	1.95	1.85	1.8	1.8	1.95	1.9	2.3	2.5	.....
13	.....	2.7	1.95	1.85	1.8	1.8	2.0	1.95	2.3	2.6	.....
14	.....	2.7	1.95	1.8	1.8	1.85	2.0	1.95	2.3	2.7	.....
15	.....	2.6	1.95	1.8	2.0	1.85	2.0	1.95	2.4	2.7	.....
16	.....	2.6	1.9	1.8	2.2	1.85	2.0	2.0	2.4	2.7	.....
17	.....	2.6	1.9	1.8	2.2	1.8	2.0	2.0	2.55	2.8	.....
18	.....	2.6	1.85	1.8	1.95	1.8	2.5	2.0	2.8	2.8	.....
19	.....	2.6	1.85	1.8	1.9	1.95	2.1	1.95	2.95	2.8	.....
20	.....	2.55	1.8	1.75	1.95	2.25	2.15	2.0	3.0	2.8	.....
21	.....	2.4	1.8	1.75	2.0	2.0	2.2	2.0	3.5	2.8	.....
22	.....	2.3	1.8	1.75	2.0	2.0	2.5	1.95	3.0	2.8	.....
23	.....	2.3	1.8	1.75	1.9	1.9	2.65	1.9	2.9	2.75	.....
24	.....	2.25	1.7	2.3	1.9	1.8	2.6	1.9	2.9	2.7	.....
25	.....	2.25	1.75	2.9	1.9	1.8	2.2	1.95	2.8	2.7	.....
26	.....	2.25	1.7	2.2	1.85	1.8	2.05	1.95	2.8	2.7	.....
27	.....	2.25	1.7	2.3	1.8	1.8	2.0	2.0	2.8	2.6	.....
28	.....	2.2	1.7	2.3	1.9	1.8	1.9	2.2	2.75	2.75	.....
29	.....	2.2	1.7	2.3	1.9	1.8	1.85	2.2	2.75	2.8	.....
30	.....	2.2	1.7	2.2	1.85	1.8	1.8	2.2	2.75	2.9	.....
31	.....	2.2	.....	2.0	.....	3.3	1.8	.....	2.75	.....	.....

NOTE.—Probable ice conditions January 1 to February 12, 1907, January 1 to March 9, and December, 1908.

Rating tables for South Platte River near Kersey, Colo. (gage No. 1).

FEBRUARY 1 TO MAY 6, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	98	2.10	143	2.60	191	3.10	275
1.60	105	2.20	151	2.70	203	3.20	310
1.70	112	2.30	160	2.80	217	3.30	350
1.80	119	2.40	170	2.90	233	3.40	390
1.90	127	2.50	180	3.00	250	3.50	435
2.00	135						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is well defined above gage height 2.5 feet.

MAY 7 TO DECEMBER 31, 1907.

2.20	70	3.20	315	4.20	795	5.20	1,420
2.30	90	3.30	355	4.30	850	5.30	1,490
2.40	110	3.40	395	4.40	905	5.40	1,565
2.50	130	3.50	440	4.50	965	5.50	1,640
2.60	150	3.60	485	4.60	1,025	5.60	1,720
2.70	170	3.70	530	4.70	1,085	5.70	1,800
2.80	195	3.80	580	4.80	1,150	5.80	1,880
2.90	220	3.90	630	4.90	1,215	5.90	1,960
3.00	250	4.00	685	5.00	1,280	6.00	2,040
3.10	280	4.10	740	5.10	1,350		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during the above period and is fairly well defined.

MARCH 10 TO NOVEMBER 30, 1908.

1.70	37	2.20	75	2.70	165	3.20	315
1.80	42	2.30	86	2.80	191	3.30	350
1.90	49	2.40	100	2.90	220	3.40	385
2.00	56	2.50	118	3.00	250	3.50	425
2.10	65	2.60	140	3.10	280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908 and is fairly well defined between gage heights 1.8 feet and 2.8 feet.

Discharge measurements of South Platte River near Kersey, Colo. (gage No. 1), in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	R. I. Meeker	135	232	3.01	446
March 29	C. L. Clatfield	148	166	2.50	330
April 8	do	136	191	2.70	378
May 31	W. B. Freeman	143	339	3.86	1,150
June 19	do	143	273	3.67	797
July 2	C. L. Chatfield	287	848	5.55	2,500
July 28	W. B. Freeman	245	795	5.58	2,730
August 20	do	54	53	1.83	59
October 12	do	134	236	3.22	508
October 22	J. B. Stewart	136	204	3.01	425
December 18[a]	do	127	179	2.90	391
1908.					
March 13	J. B. Stewart	129	153	2.80	252
May 13	W. B. Freeman	69	50	1.70	60
June 11[b]	do	42	35	1.41	37
July 22[b]	J. B. Stewart	58	48	1.94	89
August 29[b]	do	45.5	47	1.90	90
November 3	do	132	180	2.75	280

[a] Slush ice and ice around piles and on the edges.

[b] Made by wading.

Daily gage height, in feet, of South Platte River near Kersey, Colo. (gage No. 2), for 1907 and 1908.

[C. A. Maisner and Mrs. J. C. Maisner, observers.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	2.92	.....	3.25	4.50	5.20	5.15	2.15	3.18	3.05	3.10
2	.....	2.92	.....	3.32	4.40	5.38	4.85	2.02	3.28	3.10	3.10
3	.....	2.88	.....	3.28	4.40	5.22	4.68	2.00	3.30	3.10	3.10
4	.....	2.88	.....	3.25	4.75	4.90	4.52	1.95	3.30	3.15	3.10
5	.....	2.82	.....	3.38	4.42	4.65	4.48	1.88	3.35	3.15	3.10
6	.....	2.82	.....	3.48	4.28	4.75	4.15	1.82	3.28	3.15	3.10
7	.....	2.75	.....	3.72	4.55	4.38	3.58	2.00	3.22	3.15	3.10
8	.....	2.75	2.65	3.85	4.52	4.02	3.40	1.98	3.20	3.15	3.10
9	.....	2.75	2.50	3.85	4.40	3.58	3.08	2.30	3.30	3.15	3.10
10	.....	2.70	2.40	3.85	4.42	3.30	2.85	2.45	3.28	3.15	3.10
11	.....	2.70	2.25	3.88	3.90	3.35	2.72	2.10	3.25	3.20	3.10
12	.....	2.70	2.30	3.85	3.25	3.40	2.40	2.15	3.30	3.20	3.08
13	3.10	2.70	2.25	4.25	3.08	2.90	(a)	2.50	3.20	3.20	3.10
14	3.10	2.68	1.95	4.32	3.32	2.55	(a)	2.50	3.20	3.20	3.15
15	3.05	2.68	1.82	4.52	3.85	2.70	(a)	2.10	3.15	3.18	3.10
16	3.00	2.65	1.75	4.45	4.18	2.60	(a)	2.12	3.08	3.15	3.00
17	3.00	2.65	1.75	4.32	4.28	2.38	(a)	2.12	3.06	3.20	3.00
18	3.00	2.65	1.72	4.18	4.10	2.28	(a)	2.32	3.00	3.20	2.92
19	2.98	2.65	1.70	4.30	3.65	2.12	(a)	2.42	3.00	3.20	2.90
20	2.95	2.62	2.20	4.15	3.85	2.30	(a)	2.45	3.00	3.20	2.95
21	2.92	2.62	2.80	4.15	3.72	(a)	1.80	2.50	3.00	3.20	2.95
22	2.95	2.62	3.12	4.12	3.70	(a)	1.80	2.60	3.00	3.20	2.95
23	2.95	2.62	3.20	4.35	3.78	2.12	1.80	2.65	3.00	3.15	3.02
24	2.92	2.62	3.15	4.18	4.10	(a)	1.75	2.65	3.00	3.10	3.05
25	2.95	2.62	3.05	4.60	4.12	(a)	1.75	2.75	3.05	3.10	3.10
26	2.95	2.60	2.90	4.35	4.75	2.10	1.75	2.75	3.10	3.10	3.15
27	2.92	2.60	2.85	3.92	5.45	4.70	1.75	2.80	3.05	3.10	3.12
28	2.92	2.60	2.85	3.58	5.50	5.50	1.75	2.88	3.08	3.10	3.20
29	.....	2.52	3.18	3.35	5.42	5.45	1.75	2.98	3.10	3.10	3.18
30	.....	2.52	3.32	3.25	5.12	5.62	2.08	3.50	3.10	3.10	3.05
31	.....	2.52	.....	3.68	.....	5.28	2.42	.....	3.10	.....	2.95
1908.											
1	.....	.....	2.2	1.35	2.5	1.7	2.35	1.7	2.2	2.8	.....
2	.....	.....	2.2	1.35	2.0	1.6	1.85	1.7	2.2	2.7	.....
3	.....	.....	2.2	1.35	1.95	1.6	1.7	1.65	2.2	2.7	.....
4	.....	.....	2.2	.....	1.95	1.6	1.6	1.65	2.3	2.7	.....
5	.....	.....	2.15	1.85	1.8	1.6	1.6	1.65	2.3	2.7	.....
6	.....	.....	.....	2.25	1.7	1.6	1.6	1.65	2.4	2.7	.....
7	.....	.....	.....	2.25	1.6	1.6	1.65	1.65	2.4	2.65	.....
8	.....	.....	.....	2.45	1.55	1.6	1.95	1.7	2.45	2.6	.....
9	.....	.....	2.15	2.3	1.5	1.6	1.85	1.7	2.45	2.6	.....
10	.....	2.8	2.1	2.25	1.5	1.6	1.9	1.7	2.45	2.6	.....
11	.....	2.8	1.85	1.7	1.4	1.6	2.0	1.7	2.45	2.6	.....
12	.....	2.8	1.6	1.7	1.4	1.6	1.85	1.7	2.45	2.6	.....
13	.....	2.8	1.6	1.7	1.4	1.6	1.9	1.7	2.45	2.7	.....
14	.....	2.8	1.6	1.7	1.45	1.65	1.9	1.75	2.45	2.8	.....
15	.....	2.7	1.55	1.7	1.7	1.65	1.9	1.75	2.5	2.8	.....
16	.....	2.7	1.55	1.7	2.2	1.65	1.9	1.75	2.5	2.8	.....
17	.....	2.7	1.55	1.7	2.2	1.6	1.9	1.75	2.7	2.9	.....
18	.....	2.65	1.55	1.7	2.0	.....	1.9	1.75	2.9	2.9	.....
19	.....	2.6	1.55	1.7	1.9	1.8	2.25	1.75	3.0	2.9	.....
20	.....	2.6	1.5	1.7	1.9	2.0	2.2	1.75	3.1	2.9	.....
21	.....	2.6	1.4	1.6	2.0	2.0	2.25	1.8	3.15	2.9	.....
22	.....	2.5	1.45	1.6	1.95	1.9	2.6	1.75	3.3	2.9	.....
23	.....	2.4	1.45	1.6	1.8	1.8	2.75	1.75	3.0	2.85	.....
24	.....	2.4	1.3	1.9	1.8	1.6	2.8	1.8	3.0	2.8	.....
25	.....	2.4	1.3	2.65	1.8	1.6	2.3	1.8	2.9	2.8	.....
26	.....	2.4	1.3	2.5	1.75	1.6	2.2	1.9	2.9	2.8	.....
27	.....	2.4	1.3	2.4	1.75	1.6	2.05	2.05	2.9	2.7	.....
28	.....	2.35	1.3	2.4	1.75	1.6	1.9	2.2	2.85	2.8	.....
29	.....	2.3	1.35	2.4	1.7	1.6	1.75	2.2	2.85	2.9	.....
30	.....	2.3	1.35	2.25	1.7	1.6	1.7	2.2	2.85	3.0	.....
31	.....	2.2	.....	2.1	.....	3.3	1.7	.....	2.85	.....	.....

a No water under gage.

NOTE.—Probably ice conditions January 1 to February 12, 1907, January 1 to March 9, and December, 1908.

Rating tables for South Platte River near Kersey, Colo. (gage No. 2).

FEBRUARY 1 TO MAY 6, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	245	2.20	290	2.70	370	3.20	520
1.80	250	2.30	305	2.80	390	3.30	560
1.90	260	2.40	320	2.90	415	3.40	605
2.00	270	2.50	335	3.00	445	3.50	655
2.10	280	2.60	350	3.10	480		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and is well defined between gage heights 2.5 feet and 3.0 feet.

MAY 7 TO JUNE 19, 1907.

[Indirect method for shifting channels used.]

JUNE 20 TO DECEMBER 31, 1907.

1.70	20	2.70	320	3.70	770	4.70	1,585
1.80	50	2.80	355	3.80	835	4.80	1,690
1.90	80	2.90	390	3.90	905	4.90	1,800
2.00	110	3.00	425	4.00	980	5.00	1,920
2.10	140	3.10	465	4.10	1,055	5.20	2,175
2.20	170	3.20	510	4.20	1,135	5.40	2,455
2.30	200	3.30	555	4.30	1,215	5.60	2,770
2.40	230	3.40	605	4.40	1,300		
2.50	260	3.50	655	4.50	1,390		
2.60	290	3.60	710	4.60	1,485		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during this period and is not well defined.

MARCH 10 TO NOVEMBER 30, 1908.

1.30	30	1.90	89	2.50	209	3.10	373
1.40	36	2.00	105	2.60	233	3.20	410
1.50	43	2.10	122	2.70	257	3.30	450
1.60	52	2.20	142	2.80	281		
1.70	63	2.30	163	2.90	308		
1.80	75	2.40	185	3.00	338		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908 and is fairly well defined between gage heights 1.4 feet and 2.8 feet.

Daily discharge, in second-feet, of South Platte River near Kersey, Colo. (gage No. 2), May 7 to June 19, 1907.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1	.....	1,740	11	1,120	1,040	21	1,400	.....
2	.....	1,620	12	1,120	615	22	1,360	.....
3	.....	1,620	13	1,480	520	23	1,600	.....
4	.....	2,000	14	1,560	630	24	1,420	.....
5	.....	1,600	15	1,780	960	25	1,860	.....
6	.....	1,440	16	1,700	1,210	26	1,600	.....
7	920	1,700	17	1,560	1,280	27	1,200	.....
8	1,040	1,650	18	1,420	1,120	28	940	.....
9	1,070	1,460	19	1,520	790	29	790	.....
10	1,090	1,520	20	1,400	.....	30	720	.....
						31	1,010	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of South Platte River near Kersey, Colo., for 1907 and 1908.

[Drainage area, 9,470 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 13–28	730	646	677	0.071	0.04	21,500	A.
March	654	518	568	.060	.07	34,900	A.
April	955	350	550	.058	.06	32,700	B.
May	2,790	822	1,790	.189	.22	110,000	B.
June	4,330	835	2,240	.237	.26	133,000	B.
July	4,540	195	1,770	.187	.22	109,000	A.
August	3,540	121	790	.083	.10	48,600	B.
September	905	150	376	.040	.04	22,400	B.
October	915	645	759	.080	.09	46,700	A.
November	825	695	767	081	.09	45,600	A
December	790	640	707	.075	.09	43,500	B
The period						648,000	
1908.							
March 10–31	446	217	339	.036	.03	14,800	A.
April	240	67	127	.013	.01	7,560	A.
May	465	70	166	.018	.02	10,200	A.
June	265	78	128	.014	.02	7,620	A.
July	800	94	128	.014	.02	7,870	A.
August	421	94	176	.019	.02	10,800	A.
September	217	104	128	.014	.02	7,620	A.
October	817	212	399	.042	.05	24,500	A.
November	558	351	434	.046	.05	25,800	A.
The period						117,000	

NOTE.—These discharges represent the combined flow of the two channels. Discharge estimated for each channel for days on which the gage was not read.

SOUTH PLATTE RIVER NEAR JULESBURG, COLO.

This station, which is located 1 mile south of Julesburg, Colo., in T. 12 N., R. 44 W., below all irrigation ditches taking water from the South Platte in Colorado except one, was established April 2, 1902, but was not in operation during 1907. It was reestablished on May 12, 1908, at a new pile bridge about 2,000 feet upstream from the old location.

The greatest value of this station lies in the fact that it is situated less than a mile from the Colorado-Nebraska line, and its records therefore show the amount of water passing into Nebraska. It has also some importance in obtaining data on the flow of return waters.

All the tributaries for 100 miles or more above the station are intermittent streams and none are of any importance. The same may be said of the tributaries between Julesburg and North Platte, where the river joins North Platte River to form the Platte. The drainage area at Julesburg is 20,600 square miles. Numerous irrigation systems and reservoirs are located on the South Platte and tributaries above Julesburg for a distance of 250 miles. In 1907 more than 900,000 acres were irrigated in this valley. Nearly 450,000 acre-feet were stored in reservoirs, and over half of this quantity was used for

irrigation in that year. Additional rights can not be provided for in the South Platte Valley without constructing reservoirs to store surplus flood waters.

The flow of the river at Julesburg during the irrigation season depends on the amount of water diverted above and is likely to be small except when the river is in flood. During the nonirrigating season considerable water is diverted by feeder canals to storage reservoirs from the main river or its tributaries or is intercepted by reservoirs on the tributaries.

The river is usually frozen over wholly or in part for two or three months during the winter.

When the station was reestablished in 1908 the gage was moved 2,000 feet upstream and it is in no way referred to the old gage. However, the recorded gage heights give no indication of the discharge of the river from one season to the next because of the sandy and extremely shifting character of the stream bed. In low water the river consists of a number of small rivulets flowing between sand bars. In order to procure reliable results measurements should be taken as often as once every two weeks throughout the year.

Discharge measurements of South Platte River near Julesburg, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Old gage.	New gage.	
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
May 12	W. B. Freeman	56	24	1.35	1.30	29
June 10	do	191	38	1.48	1.34	45
July 22	J. B. Stewart			1.38	1.22	36
August 21[a]	do	132	47		1.33	64
November 2	do	112	88	1.65	1.45	140

[a] Made by wading.

Daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1908.

[Mrs. W. K. Green and Miss May C. Wood, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.3	1.3	1.3	1.2			
2		1.3	1.3	1.2	1.3		1.45	
3		1.2	1.2	1.2	1.3		1.4	
4		1.2	1.2	1.2	1.2		1.4	1.65
5		1.2	1.3	1.2	1.3		1.35	1.7
6		1.2	1.4	1.3	1.3		1.4	
7		1.2	1.3	1.3	1.3		1.4	2.1
8		1.2	1.3	1.2	1.2			
9		1.2	1.2	1.3	1.2			2.3
10		1.35	1.2	1.2	1.2			
11		1.3	1.1	1.3	1.2			2.3
12	1.3	1.2	1.3	1.2	1.4			2.2
13	1.4	1.3	1.2	1.2	1.2		1.4	
14	1.6	1.2	1.3	1.3	1.2			2.4
15	1.5	1.2	1.3	1.2	1.2			

Daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1908— Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.5	1.5	1.2	1.3	1.3	.....	1.45	.....
17	1.5	1.55	1.2	1.3	1.2	.....	1.45	2.5
18	1.5	1.5	1.3	1.4	1.2	.....	1.45	2.4
19	1.4	1.4	1.4	1.4	1.2	.....	1.5	.....
20	1.5	1.4	1.3	1.3	1.2	.....	1.5	.....
21	1.5	1.4	1.2	1.3	1.2	.....	1.55	2.15
22	1.3	1.2	1.4	1.4	1.2	.....	.....	.....
23	1.3	1.3	1.5	1.3	1.2	.....	1.6	1.95
24	1.5	1.3	1.4	1.4	1.2	.....	1.6	2.0
25	1.5	1.2	1.35	1.3	1.2	.....	1.6	.....
26	1.9	1.4	1.3	1.3	1.2	.....	1.5	.....
27	1.8	1.2	1.3	1.3	1.2	.....	.....	.....
28	1.6	1.2	1.4	1.25	1.3	.....	.....	.....
29	1.5	1.2	1.3	1.3	1.2	.....	.....	.....
30	1.5	1.2	1.4	1.3	1.2	.....	1.4	.....
31	1.4	.....	1.3	1.2	.....	.....	.....	.....

NOTE.—Probable ice conditions during December.

Rating tables for South Platte River near Julesburg, Colo.

MAY 12 TO JUNE 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	12	1.40	70	1.60	240	1.80	500
1.30	29	1.50	140	1.70	360	1.90	660

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during May and June and is not well defined.

JUNE 11 TO DECEMBER 31, 1908.

1.10	20	1.30	54	1.50	188	1.60	307
1.20	32	1.40	102				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and is fairly well defined.

Monthly discharge of South Platte River near Julesburg, Colo., for 1908.

[Drainage area, 20,600 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
May 12–31	660	29	167	0.0081	0.006	6,620	C.
June	248	12	57.6	.0028	.003	3,430	B.
July	188	20	61.6	.0030	.003	3,790	B.
August	102	32	52.7	.0026	.003	3,240	B.
September	102	32	39.5	.0019	.002	2,350	B.
November	307	78	154	.0075	.008	9,160	C.

NOTE.—Discharge interpolated for missing days in November.

NORTH FORK OF SOUTH PLATTE RIVER AT CASSELLS, COLO.

This station, which is located at Cassells, Colo., was established July 4, 1908, to determine the value of the stream for power development.

Geneva Creek, one of the most important tributaries, comes in about 2 miles above, and supplies a large part of the water passing the station.

The drainage area above the station comprises about 100 square miles, a considerable part of which is timbered. No diversions of any importance are made above this point on the main stream or any of its tributaries, but many filings have been made for power sites, especially on Geneva Creek. Additional power sites are, however, probably available.

The stream is liable to freeze over from the middle of November to the 1st of April.

No change has been made in the datum of the gage since it was first established.

Very good results should be obtained except in extremely high water. Measurements can be taken by wading the greater part of the year. Frequent measurements are necessary to determine the winter flow accurately.

Discharge measurements of North Fork of South Platte River at Cassells, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Freeman and Stewart	28.5	52	1.37	89
July 4	J. B. Stewart	28.5	55	1.30	78
September 5	do	29	47	1.05	37
October 27	do	29	55	1.30	[a] 29
December 15[b]	W. B. Freeman	9.5	17.3	1.44	13.4
December 16[b]	do	11	22.4	1.47	18.6
December 30[b]	do	16.7	12.3	1.10	15.1
December 31[b]	do	16.5	11.6	1.10	12.8

[a] Discharge probably low. Some ice. [b] Made by wading. Ice conditions.

Daily gage height, in feet, of North Fork of South Platte River at Cassells, Colo., for 1908.

[Lulu Cassell, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.2	.....	1.15	1.2	0.7	16	1.45	1.2	.....	1.05	1.1	1.45
2	.....	1.2	.....	1.1	1.1	.8	17	1.25	1.25	.....	1.1	1.2	1.45
3	.....	1.25	.....	1.1	1.15	.8	18	1.3	1.2	.....	1.0	1.2	1.45
4	1.3	1.2	1.1	1.1	1.2	.8	19	1.25	1.2	.....	.9	1.2	1.3
5	1.2	1.25	.....	1.1	1.1	.75	20	1.2	1.3	.....	1.0	1.1	1.35
6	1.2	1.2	.....	1.05	1.2	.8	21	1.3	1.2	.....	1.3	1.1	1.3
7	1.3	1.15	.....	1.1	1.05	.9	22	1.2	1.3	.....	1.3	1.1	1.3
8	1.2	1.25	.....	1.1	1.1	.8	23	1.2	1.3	.....	1.25	1.0	1.2
9	1.15	1.15	.....	1.1	1.2	.7	24	1.15	1.2	.....	1.25	1.1	1.15
10	1.15	1.2	.....	1.1	1.2	.9	25	1.25	1.2	.....	1.15	1.1	1.1
11	1.2	1.2	.....	1.1	1.2	1.3	26	1.2	1.15	.....	1.2	.9	1.1
12	1.25	1.2	.....	1.1	1.0	1.4	27	1.1	1.25	.....	1.3	.8	1.1
13	1.3	1.3	.....	1.05	1.0	1.4	28	1.2	1.2	.....	1.3	.8	1.1
14	1.3	1.3	.....	1.0	1.0	1.45	29	1.3	1.3	.....	1.25	.9	1.05
15	1.25	1.2	.....	1.0	1.0	1.45	30	1.2	1.25	.....	1.2	.9	1.1
							31	1.3	1.2	.....	1.2	.....	1.1

NOTE.—Ice conditions November 15 to December 31, 1908.

Rating table for North Fork of South Platte River at Cassells, Colo., for July 1 to August 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	21	1.10	45	1.30	77	1.50	113
1.00	31	1.20	61	1.40	95		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during July and August, 1908, and is well defined between gage heights 1.0 foot and 1.4 feet.

Monthly discharge of North Fork of South Platte River at Cassells, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July	104	45	68.4	4,210	A.
August	77	53	64.9	3,990	A.
December	21	13	15.5	953	C.

NOTE.—December estimated on account of ice conditions.

GENEVA CREEK NEAR GRANT, COLO.

This station, which is located at Sullivan's ranch, 3½ miles above Grant, Colo., in T. 6 S., R. 74 W., was established July 5, 1908, to obtain data concerning the run-off from a small mountain drainage area and also to determine the flow available for power development.

The station is about 3½ miles above the confluence of Geneva Creek with the North Fork of the South Platte, about 50 feet below the mouth of Gold Run, or Threemile Creek, and about a mile below the mouth of Scott Gomer Gulch, which is called on some of the old maps the North Fork of the South Platte. The drainage area, which is very mountainous and part of which area is heavily timbered, comprises 49 square miles above the station.

No water is diverted above the station. Several power sites have been filed on, but the stage of construction at none of these has yet been reached. The creek has a fall of 900 feet in the last 4 miles, and a very much greater fall above. With proper storage it will be possible to develop 10,000 horsepower during a six months' period. The development of the Continental reservoir site, about 3 miles above the station, is under consideration.

The creek is frozen wholly or in part for four or five months during the year.

The datum of the gage has not been changed since the station was established.

Very good results should be obtained except at very high stages, when the current is likely to be swift. Measurements can be made by wading at most seasons of the year, but for flood measurements a cable must be installed.

Discharge measurements of Geneva Creek near Grant, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Freeman and Stewart	24	34	0.65	70
July 5	J. B. Stewart	29	32	.60	50
September 4	do	25	25.2	.48	32
October 25	do	23	26	.48	29
December 15[a]	W. B. Freeman	11.5	15.8	.35	14.6
December 28[a]	do	11	9.8	.20	11.2
December 29[a]	do	13	10.6	.20	14.1

[a] Ice conditions.

NOTE.—All measurements made by wading.

Daily gage height, in feet, of Geneva Creek near Grant, Colo., for 1908.

[J. Bruce Mather and Edward Sullivan, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.65	0.5	0.45	0.5	16	0.7	0.7	0.5	0.4	.....
2	.....	.65	.55	.4	.4	17	.7	.7	.5	.4	.....
3	.....	.6	.55	.4	.4	18	.65	.8	.45	.4	.....
4	.....	.6	.6	.35	.4	19	.7	.75	.4	.4	.....
5	0.6	.6	.55	.35	.45	20	.65	.7	.4	.45	.....
6	.65	.7	.5	.35	.4	21	.75	.7	.4	.4	.....
7	.6	.65	.45	.4	.45	22	.65	.6	.4	.5	.....
8	.6	.6	.5	.35	.4	23	.65	.6	.4	.4	.....
9	.7	.6	.45	.4	.4	24	.65	.6	.4	.4	.....
10	.7	.6	.5	.4	.5	25	.6	.6	.4	.4	.....
11	.7	.6	.4	.4	.4	26	.5	.55	.5	.4	.....
12	.7	.6	.4	.4	.5	27	.5	.6	.4	.4	.....
13	.65	.65	.5	.4	.45	28	.5	.55	.45	.4	.....
14	.7	.65	.5	.4	.4	29	.5	.5	.4	.4	.....
15	.7	.6	.55	.35	.5	30	.65	.55	.4	.45	.....
						31	.65	.55	.....	.5	.....

NOTE.—Ice conditions November 15 to December 31.

Rating table for Geneva Creek near Grant, Colo., for July 1 to November 14, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	14	0.50	33	0.70	81
.40	21	.60	54	.80	112

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908, and is fairly well defined between gage heights 0.30 foot and 0.65 foot.

Monthly discharge of Geneva Creek near Grant, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July	96	33	64.3	3,950	B.
August	112	33	61.6	3,790	B.
September	54	21	29.3	1,740	A.
October	33	17	21.6	1,330	A.
November	33		21.3	1,270	C.
December			14.3	879	C.
The period				13,000	

NOTE.—Discharge estimated for period July 1–4. Discharges for frozen period, November 15 to December 31, have been estimated on the basis of three measurements.

CLEAR CREEK AT FORKSCREEK, COLO.

This station, which is located at Forkscreek, Colo., in T. 3 S., R. 71 W., was established May 29, 1899, to determine the amount of water available for irrigation and power development.

The station is a few hundred feet below the mouth of the North Fork. No other important tributaries enter between this fork and the mouth of the stream. For 13 miles below the station the creek flows in a deep canyon, falling in that distance 1,225 feet. It then emerges into a broad valley, where the entire normal flow is used for irrigation. The drainage area above the station comprises a narrow strip of very mountainous country, composed entirely of granitic rock, in many places barren of soil and studded with heavy patches of coniferous timber, remnants of a once extensively forested area. This area is 345 square miles.

Two of the oldest mining districts in Colorado lie in this basin, and in these districts the waters of the upper tributaries of the stream have been used for mining. The stream now carries in suspension immense quantities of tailings and sediment, and the name Clear Creek has long been a misnomer.

The water is used to some extent for power, and 4,000 horsepower are at present developed by about a dozen small plants. Several other plants are planned or in the course of construction. By utilizing all the storage facilities on the stream above Forkscreek it will be possible to develop about 30,000 horsepower for six months during the year, and 20,000 more between that point and its mouth.

The natural flow of the stream is more or less affected by storage in various ponds and reservoirs above. The creek is frozen over for three or four months during the winter.

On July 19, 1905, the gage was moved 30 feet upstream from its original location, but it is not likely that the relation of gage heights was materially affected thereby. Very good results should be ob-

tained at this station except in times of high water, when it is very difficult to measure on account of the swiftness of the current. As the channel is occasionally shifted by floods, new rating curves must from time to time be constructed.

The creek is subject to disastrous floods, due to the heavy rains in summer months, which frequently wash out the tracks of the Colorado and Southern Railway in the bottom of the canyon.

About December 1, 1908, the Denver Reservoir and Irrigation Company established a station about 2 miles above Golden and 10 miles below Forkscreek, and discharges for December are based on records at this station.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 15[a]	C. L. Chatfield	22	21	1.90	35
March 16	do	27	22	1.98	35
Do	do	28	28	2.10	49
April 11	do	33	44	2.70	120
April 23	do	30	46	2.75	134
May 10	do	32	52	2.90	177
June 3	W. B. Freeman	36	90	3.77	502
June 18	do	36	136	4.77	1,070
July 19	do	42	110	5.53	553
August 9	do	37	74	5.00	314
September 9	do	28.5	52	4.57	158
October 11	Freeman and Stewart	27.5	41	4.40	100
December 5	J. B. Stewart	25	31	4.05	49
1908.					
February 20[b]	J. B. Stewart	14	27	5.22	63
March 16	do	30	16	4.00	41
May 21	do	34	58	4.88	247
June 17	do	44	104	5.88	525
August 15	do	39	48	5.20	172
October 30	do	38	29	5.02	78
December 11[b]	W. B. Freeman	28	43	5.37	48
Do.[b]	do	21	42	5.46	51

[a] Ice conditions. [b] Measured by wading; ice conditions.

Discharge measurements of Clear Creek near Golden, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 4	S. Krajicek	30	40	0.43	64
December 12	do	30	27.4	.02	37
Do	W. B. Freeman	20	31	.02	36
December 28	S. Krajicek			1.42	65

Daily gage height, in feet, of Clear Creek near Forkscreek, Colo., for 1907 and 1908.

[C. W. Hoisington, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1				2.45	2.85	3.65	4.95	5.30	4.70	4.45	4.28	
2				2.43	2.70	3.75	5.00	5.30	4.70	4.45	4.25	
3				2.45	2.80	3.88	4.95	5.25	4.70	4.48	4.25	
4				2.53	2.83	3.90	4.95	5.22	4.65	4.45	4.28	
5				2.50	2.80	4.00	4.90	5.15	4.65	4.45	4.25	4.05
6				2.50	2.75	4.22	4.80	5.10	4.60	4.45	4.25	
7			1.83	2.47	2.85	4.25	4.75	5.05	4.60	4.58	4.22	
8			1.85	2.47	2.85	4.30	4.75	5.00	4.55	4.55	4.22	
9			1.87	2.47	2.93	4.20	[a]5.50	5.00	4.55	4.45	4.22	
10			1.93	2.60	2.90	4.15	6.15	5.00	4.55	4.42	4.15	
11			2.00	2.77	3.13	4.22	5.85	4.95	4.52	4.40	3.70	
12			2.05	2.70	3.20	4.38	5.85	4.90	4.50	4.40	3.80	
13			2.07	2.70	3.33	4.48	5.85	4.90	4.45	4.40	3.85	
14			2.03	2.77	3.27	4.60	5.90	4.88	4.40	4.40	3.85	
15			1.97	2.85	3.30	4.72	5.78	4.90	4.45	4.40	3.85	
16			2.00	3.00	3.37	4.80	5.65	4.85	4.45	4.35	3.85	
17			2.33	2.93	3.37	4.62	5.60	4.80	4.45	4.35		
18			2.35	2.85	3.45	4.82	5.55	4.75	4.45	4.35		
19			2.37	2.80	3.60	4.98	5.52	4.75	4.45	4.30		
20			2.43	2.77	3.80	4.58	5.48	4.78	4.45	4.30		
21			2.47	2.80	3.97	4.58	5.35	4.80	4.45	4.30		
22			2.43	2.83	4.23	4.55	5.35	4.75	4.45	4.30		5.60
23			2.40	2.80	4.23	4.68	5.55	4.70	4.45	4.30		5.60
24			2.37	2.80	4.20	4.75	5.55	4.70	4.25	4.30		5.05
25			2.37	2.83	4.05	4.95	5.52	4.85	4.28	4.30		4.95
26			2.47	2.60	3.90	4.98	5.82	4.75	4.42	4.30		4.85
27			2.47	2.77	3.83	5.05	5.70	4.75	4.48	4.30		4.70
28			2.45	2.70	3.75	5.05	5.60	4.70	4.42	4.30		4.55
29			2.25	2.83	3.70	4.95	5.50	6.85	4.45	4.30		4.35
30			2.30	2.95	3.63	4.98	5.38	4.78	4.42	4.28		4.85
31			2.33		3.60		5.38	4.70		4.28		4.95
1908.												
1	4.9	5.45	4.0	3.9	4.1	5.0	5.5	5.4	5.1	5.0	5.0	5.6
2	4.85	5.45	4.1	3.75	4.3	5.2	5.35	5.4	5.1	5.0	5.0	5.65
3	4.75	5.4	4.1	3.7	4.5	5.3	5.35	5.3	5.1	5.0	5.0	5.8
4	4.95	5.3	4.0	3.9	4.55	5.5	5.35	5.2	5.1	5.0	5.0	5.65
5	5.0	5.25	4.0	3.8	4.6	5.4	5.35	5.2	5.1	5.0	5.0	5.5
6	4.9	5.2	4.0	3.8	4.6	5.4	5.35	5.2	5.1	5.0	5.0	5.4
7	5.15	5.2	3.85	4.2	4.6	5.3	5.3	5.25	5.1	5.0	5.0	5.5
8	5.2	5.2	3.85	3.9	4.55	5.25	5.3	5.2	5.1	5.0	5.0	5.6
9	5.3	5.2	3.75	3.95	4.65	5.3	5.3	5.2	5.1	5.0	5.0	5.55
10	5.4	5.3	3.9	4.0	4.55	5.6	5.3	5.2	5.1	5.0	5.0	5.45
11	5.35	5.3	3.85	4.15	4.55	5.8	5.3	5.2	5.1	5.0	4.9	5.4
12	5.35	5.2	3.95	4.2	4.6	5.9	5.25	5.25	5.1	4.9	5.0	5.3
13	5.35	5.2	3.95	4.4	4.55	5.7	5.3	5.2	5.1	4.9	4.95	5.35
14	5.45	5.15	3.95	4.4	4.5	5.8	5.25	5.2	5.1	4.9	4.95	5.3
15	5.45	5.2	4.0	4.4	4.6	5.9	5.25	5.2	5.2	4.9	5.05	5.35
16	5.35	5.15	4.05	4.5	4.6	5.75	5.25	5.2	5.15	4.95	5.2	5.4
17	5.35	5.15	4.15	4.5	4.65	5.9	5.25	5.5	5.1	5.0	5.3	5.3
18	5.45	4.95	4.15	4.5	4.7	5.7	5.2	5.4	5.1	4.95	5.2	5.5
19	5.4	4.95	4.0	4.25	4.8	5.5	5.1	5.4	5.1	4.95	5.2	5.6
20	5.35	5.2	3.9	4.35	5.05	5.45	5.1	5.5	5.1	4.95	5.2	5 7
21	5.3	5.15	3.85	4.5	4.9	5.5	5.1	5.65	5.1	4.95	5.2	5.75
22	5.3	4.95	3.85	4.6	4.9	5.7	5.1	5.8	5.1	4.95	5.2	5.65
23	5.2	4.8	3.85	4.7	4.9	5.6	5.05	5.4	5.1	5.0	5.1	5.8
24	5.35	4.5	3.8	4.6	5.0	5.65	5.05	5.4	5.0	5.0	5.0	5.9
25	5.2	4.7	3.9	4.55	5.0	5.6	5.0	5.35	5.0	4.95	4.9	5.85
26	5.15	4.95	3.8	4.45	5.0	5.6	4.9	5.3	5.1	4.95	4.9	5.75
27	5.15	4.75	4.0	4.3	4.95	5.65	4.85	5.3	5.15	4.95	5.0	5.7
28	5.2	4.2	3.95	4.4	4.9	5.65	4.85	5.2	5.1	5.0	5.2	5.6
29	5.1	4.0	3.8	3.85	4.85	5.5	4.9	5.2	5.0	5.0	5.3	5.55
30	5.0		4.0	4.1	4.85	5.2	5.1	5.2	5.0	5.0	5.45	5.35
31	5.1		3.95		4.8		5.0	5.15		5.0		5.0

[a] Maximum gage height was 9.2 feet.

NOTE.—Ice conditions January 1–March 6, 1907; November 17, 1907, to February 27, 1908, and after November 14, 1908.

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Rating tables for Clear Creek at Forkscreek, Colo.

MARCH 7 TO JULY 9, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	28	2.70	119	3.60	423	4.50	895
1.90	32	2.80	142	3.70	469	4.60	951
2.00	37	2.90	169	3.80	517	4.70	1,009
2.10	44	3.00	199	3.90	568	4.80	1,068
2.20	52	3.10	231	4.00	622	4.90	1,129
2.30	61	3.20	265	4.10	676	5.00	1,192
2.40	72	3.30	301	4.20	730	5.20	1,321
2.50	85	3.40	339	4.30	785	5.40	1,453
2.60	100	3.50	380	4.40	840	5.60	1,587

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during this period and is well defined between gage heights 1.8 feet and 4.8 feet.

JULY 10, 1907, TO MAY 20, 1908.

3.70	23	4.40	103	5.10	351	5.80	676
3.80	29	4.50	133	5.20	394	5.90	724
3.90	36	4.60	165	5.30	439	6.00	773
4.00	43	4.70	199	5.40	485	6.10	823
4.10	52	4.80	234	5.50	532	6.20	873
4.20	63	4.90	271	5.60	580		
4.30	80	5.00	310	5.70	628		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during this period and is well defined between gage heights 4.0 feet and 5.7 feet.

MAY 21 TO NOVEMBER 20, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Clear Creek at Forkscreek, Colo., for 1908.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		268	350	280	130	92	74	58
2		328	290	270	130	92	74	58
3		370	285	230	130	92	74	58
4		460	285	195	130	92	74	64
5		410	285	195	130	92	74	65
6		400	285	195	130	92	74	64
7		365	265	212	130	92	74	50
8		335	265	188	125	84	74	55
9		332	260	188	125	84	74	53
10		460	260	188	125	84	74	58
11		550	260	188	125	84	60	50
12		600	242	204	125	67	74	48
13		460	260	188	125	67	66	48
14		510	242	172	125	67	66	49
15		550	236	172	155	67	70	54
16		470	236	172	138	76	70	55
17		535	236	284	125	84	70	63
18		445	220	245	125	76	65	52
19		360	182	245	125	76	65	42
20		340	182	284	125	76	65	49
21	250	355	176	340	125	76	65	65
22	250	440	176	405	125	76	65	65
23	240	395	158	245	114	74	65	67
24	280	415	158	235	92	74	65	67
25	280	395	142	215	92	66	60	66
26	264	395	115	198	114	66	60	77
27	246	412	100	198	126	66	60	79
28	228	412	100	162	114	74	60	71
29	210	350	110	162	92	74	60	58
30	214	232	170	162	92	74	60	41
31	195	.....	138	146	.....	74	.....	48

NOTE.—These discharges were obtained by the indirect method for shifting channels, May 21 to November 14; were estimated November 15 to 30; and are from records kept by the Denver Reservoir and Irrigation Company, at a station 2 miles above Golden for December.

Monthly discharge of Clear Creek at Forkscreek, Colo., for 1907 and 1908.

[Drainage area, 345 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 7–31	81	29	56.7	0.164	0.15	2,810	B.
April	199	76	124	.359	.40	7,380	A.
May	746	119	363	1.05	1.21	22,300	A.
June	1,220	446	903	2.62	2.92	53,700	A.
July	1,520	462	760	2.20	2.54	46,700	A.
August	439	199	277	.803	.93	17,000	A.
September	199	72	134	.388	.43	7,970	A.
October	159	77	99.3	.288	.33	6,110	A.
November 1–16	77	32	54.9	.159	.09	1,740	B.
The period						166,000	
1908.							
January			50	.145	.17	3,070	D.
February			55.2	.160	.17	3,180	D.
March	58	26	39.5	.114	.13	2,430	B.
April	199	23	85.0	.246	.27	5,060	A.
May	330	52	191	.554	.64	11,700	A.
June	600	232	412	1.19	1.33	24,500	B.
July	350	100	215	.623	.72	13,200	B.
August	405	146	218	.632	.73	13,400	B.
September	155	92	122	.354	.40	7,260	B.
October	92	66	78.4	.227	.26	4,820	B.
November			67.7	.196	.22	4,030	D.
December			58.0	.168	.19	3,570	D.
The year			133	.384	5.23	96,200	

NOTE.—Discharge estimated January 1 to February 27, 1908, and November 15 to December 31, 1908.

BOULDER CREEK AT ORODELL, COLO.

This station, which was established March 18, 1907, is located just above the mouth of Fourmile Creek, about 4 miles above Boulder, Colo. The records are valuable chiefly in connection with power development. Boulder Creek has an immense amount of fall, and the distance from the Continental Divide at its headwaters to the plains at Boulder is only 20 miles.

No diversions are made above the station. The first canal has its intake a short distance below.

The creek is frozen four or five months of the year and discharges for such periods have been obtained by interpolation between discharge measurements and weir records.

The records at this station since May 20, 1907, have been kept and furnished by the Central Colorado Power Company.

Discharge measurements of Boulder Creek at Orodell, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 19[a]	C. L. Chatfield	31	31	1.90	37
April 12[a]	do	37	44	2.15	58
April 22	do	34	37	2.04	44
Do	do	37	52	2.40	89
May 14	do	30	70	2.80	[b] 199
June 3	R. I. Meeker			3.20	[b] 334
June 13	do			3.35	[b] 409
July 3	do			3.82	[b] 605
July 13	do			3.58	[b] 503
August 25[a]	Meeker and Chatfield	37	45	2.33	93
September 3[a]	C. L. Chatfield	46	52	2.31	100
September 7[a]	do	44	47	2.13	78
September 21[a]	do	45	49	2.25	76
October 5[a]	do	38	34	1.93	36
October 6[a]	do	37	34	1.92	36
October 14[a]	do	31	30	1.82	26
October 18[a]	do	31	28	1.78	22
October 31[a]	do	31	30	1.84	27
November 10	R. I. Meeker	24	24.4	1.68	17.5
November 16[c]	do	22	29	2.03	19.4
November 23[c]	do	20	23.7	2.02	14.6
November 30[c]	do	17	17.0	1.80	14.7
December 6[c]	do	19	13.5	1.50	10.0
December 14[c]	do	18	19.1	1.70	7.7
December 24[c]	do	10	8.3		6.4
1908.					
January 12	R. I. Meeker	9	9.6		[d] 6.1
January 17	do	5.5	7.0		[e] 5.1
January 19	do	5.5	4.6		5.8
Do[a]	do		5.9		6.5
February 20	do	6.0	4.6		4.8
March 14[a]	C. L. Chatfield	29	21.3	1.57	11.8
March 21	do	29	21.3	1.49	[f] 10.0
March 28	do	29	21.1	1.49	9.8
April 22	do	37	50	2.32	86
June 29	do	45	72	2.75	186
Do	do			2.75	[b] 185
July 15	do	45	70	2.72	180
August 1	do	47	67	2.68	[g] 194
August 13	do	42.5	56	2.52	134
September 2	do	37.5	44	2.22	76
November 2	do	30	22	1.64	16.5
November 20[c]	do	27.5	22.6	1.62	15.2
December 7[c]	do	23	13.7	1.82	11.3
December 8[h]	do	13	14.3	[i] .74	13.4
Do	do				[b] 15.28
December 28[h]	do	13	10.6	[i] .52	8.2
December 29[h]	do	13	10.0	[i] .47	7.3

[a] Made by wading.
[b] Measurement made at Ninth street bridge, Boulder, and the algebraic sum of all inflow and diversions between it and the Orodell station added.
[c] Ice conditions.
[d] Discharge over weir at power house gave 3.28 second-feet.
[e] Discharge over weir at power house gave 3.03 second-feet.
[f] Discharge over weir at power house gave 5.8 second-feet.
[g] Results rough. Poor measuring section.
[h] Measurement made at temporary station at power house.
[i] Gage at power house.

Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1907 and 1908.

[Mrs. W. Laffea, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		1.85	2.38	3.00	3.95	2.98	2.42	2.06		1.55
2		1.85	2.42	3.12	3.92	2.95	2.38	2.10		
3		1.95	2.40	3.22	3.88	2.92	2.34	1.92	1.74	
4		2.05	2.45	3.18	3.85	3.00	2.30	1.87	1.73	
5		1.98	2.45	3.35	3.80	2.85	2.33	1.88	1.70	
6		1.95	2.42	3.48	3.80	2.80	2.32	1.91	1.71	1.48
7		1.88	2.45	3.48	3.80	2.80	2.20	2.05	1.69	
8		1.90	2.55	3.50	3.78	2.82	2.22	1.98	1.69	
9		1.95	2.60	3.40	3.70	2.80	2.20	1.90	1.68	
10		2.00	2.65	3.22	3.65	2.78	2.13	1.87	1.66	

Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1907 and 1908—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
11	.....	2.25	2.78	3.25	3.60	2.75	2.09	1.87	.....	.....
12	.....	2.18	2.90	3.35	3.50	2.75	2.08	1.85	.....	.....
13	.....	2.15	2.98	3.42	3.58	2.60	2.08	1.83	.....	.....
14	.....	2.25	2.88	3.58	3.62	2.58	2.13	1.82	.....	.....
15	.....	2.30	2.85	3.70	3.52	2.65	2.12	1.83	.....	.....
16	.....	2.32	2.82	3.65	3.35	2.65	2.10	1.81	.....	.....
17	.....	2.32	2.95	3.58	3.10	2.55	2.07	1.80	.....	.....
18	1.75	2.28	3.00	3.72	3.12	2.60	2.05	1.78	.....	.....
19	1.98	2.15	3.20	3.70	3.15	2.65	2.04	1.87	.....	.....
20	1.95	2.15	3.35	3.55	3.20	2.62	2.07	1.84	.....	.....
21	2.00	2.20	3.35	3.58	3.30	2.52	2.25	1.82	1.71	.....
22	2.00	2.20	3.35	3.60	3.22	2.45	2.21	1.78	.....	.....
23	2.00	2.28	3.35	3.58	3.18	2.35	2.09	1.78	.....	.....
24	1.95	2.35	3.35	3.65	3.15	2.35	1.81	1.81	.....	.....
25	2.00	2.32	3.30	3.68	3.12	2.38	1.80	1.87	1.60	.....
26	2.05	2.32	3.05	3.60	3.55	2.55	1.88	.....	1.57	.....
27	2.02	2.42	2.92	3.60	3.48	2.60	2.13	.....	1.57	.....
28	1.95	2.48	2.92	3.65	3.58	2.55	2.06	.....	.....	.....
29	1.85	2.52	2.90	3.70	3.35	2.50	1.86	.....	.....	.....
30	1.88	2.50	3.02	3.88	3.08	2.50	2.03	.....	1.55	.....
31	1.88	.....	3.00	.....	3.00	2.45	.....	.....	.....	.....
1908.										
1	.....	1.44	2.03	2.68	2.73	2.69	2.18	1.91	1.69	1.58
2	.....	1.46	2.23	2.71	2.75	2.65	2.21	1.88	1.64	1.64
3	.....	1.48	2.37	2.77	2.71	2.68	2.09	1.86	1.62	1.69
4	.....	1.54	2.27	2.94	2.74	2.58	2.05	1.79	1.63	1.59
5	.....	1.54	2.20	2.82	2.74	2.53	2.01	1.76	1.64	1.51
6	.....	1.59	2.09	2.75	2.67	2.54	2.14	1.73	1.66	1.44
7	.....	1.65	2.23	2.76	2.66	2.55	2.19	1.70	1.61	1.48
8	.....	1.62	2.40	2.74	2.69	2.54	2.10	1.69	1.61	1.46
9	1.49	1.65	2.48	2.83	2.66	2.49	2.90	1.68	1.64	1.45
10	1.54	1.76	2.31	2.91	2.66	2.43	2.21	1.67	1.60	1.51
11	1.50	1.88	2.23	3.05	2.64	2.55	2.12	1.67	1.94	1.53
12	1.47	1.97	2.22	3.14	2.73	2.58	2.12	1.66	1.97	1.53
13	1.53	2.09	2.20	3.17	2.88	2.56	2.17	1.64	1.93	1.48
14	1.57	2.16	2.15	3.14	2.82	2.48	2.20	1.62	1.96	1.47
15	1.63	2.26	2.18	3.23	2.75	2.48	2.22	1.61	1.91	1.44
16	1.62	2.29	2.36	3.26	2.74	2.43	2.18	1.60	1.80	1.48
17	1.65	2.24	2.49	3.29	2.68	2.39	2.14	1.61	1.74	1.49
18	1.69	2.26	2.46	3.10	2.64	2.49	2.10	1.68	1.70	.....
19	1.58	2.29	2.57	2.91	2.58	2.55	2.06	1.72	1.67	.....
20	1.48	2.22	2.69	2.89	2.53	2.56	2.04	1.71	1.66	.....
21	1.56	2.28	2.54	2.97	2.51	2.50	2.02	1.72	1.69	.....
22	1.56	2.39	2.54	3.06	2.49	2.51	2.02	1.77	1.68	.....
23	1.51	2.37	2.46	3.01	2.50	2.49	2.00	1.71	1.66	.....
24	1.55	2.17	2.64	3.01	2.50	2.47	1.97	1.78	1.65	.....
25	1.52	2.12	2.60	3.04	2.49	2.40	1.91	1.72	1.68	.....
26	1.54	2.02	2.48	2.97	2.51	2.37	1.91	1.67	1.69	.....
27	1.56	1.96	2.48	3.13	2.53	2.32	1.95	1.70	1.70	.....
28	1.52	1.95	2.37	2.92	2.52	2.23	1.96	1.73	1.71	.....
29	1.46	1.88	2.45	2.75	2.70	2.22	1.97	1.72	1.68	.....
30	1.54	1.90	2.54	2.75	2.66	2.22	1.95	1.69	1.65	.....
31	1.49	.....	2.57	.....	2.73	2.19	.....	1.70	.....	.....

NOTE.—Gage readings after September 1, 1907, were taken from a Friez automatic gage.
Probable ice conditions January 1 to March 17, 1907, November 1, 1907 to March 8, 1908, and December, 1908.

Rating table for Boulder Creek at Orodell, Colo., for 1907 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	10	2.10	57	2.70	171	3.30	377
1.60	13	2.20	70	2.80	200	3.40	420
1.70	18	2.30	85	2.90	230	3.50	465
1.80	26	2.40	103	3.00	263	3.60	510
1.90	35	2.50	123	3.10	299	3.70	555
2.00	45	2.60	145	3.20	337		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on daily gage heights and discharges furnished by the Central Colorado Power Company and is well defined.

Daily discharge, in second-feet, of Boulder Creek at Orodell, Colo., February 4 to March 8, and December 18–31, 1908.

Day.	Feb.	Mar.	Dec.	Day.	Feb.	Mar.	Dec.
1		5.5		16	5.2		
2		7.0		17	5.2		
3		7.0		18	4.9		9.1
4		7.0		19	4.6		9.8
5	5.4	7.2		20	4.4		10.0
6	5.3	7.5		21	4.8		9.7
7	5.4	8.5		22	5.1		8.6
8	5.3	9.0		23	5.4		8.6
9	5.5			24	5.8		8.8
10	5.6			25	6.0		9.7
11	5.6			26	6.1		8.6
12	5.2			27	6.9		8.6
13	5.4			28	7.4		8.6
14	5.3			29	7.4		8.6
15	5.2			30			8.6
				31			8.6

NOTE.—These discharges were obtained from weir measurements. Records were also kept January 1 to February 4, but as the weir leaked, they have been discarded.

Monthly discharge of Boulder Creek at Orodell, Colo., for 1907 and 1908.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 18–31	51	22	39.9	0.369	0.19	1,110	B.
April	127	30	70.4	.652	.73	4,190	A.
May	398	100	234	2.17	2.50	14,400	A.
June	636	263	467	4.32	4.82	27,800	A.
July	670	263	460	4.26	4.91	28,300	A.
August	263	94	164	1.52	1.75	10,100	A.
September	107	26	62.4	.578	.64	3,710	A.
October	57	24	32.0	.296	.33	1,970	A.
November	24	11	15.9	.147	.16	946	C.
December	11		7.83	.070	.08	481	C.
The period						93,000	
1908.							
January			4.5	.042	.05	277	C.
February			5.5	.051	.06	316	C.
March	17.4		10.4	.096	.11	640	B.
April	101	8.2	46.5	.431	.48	2,770	A.
May	167	49	103	.954	1.10	6,330	A.
June	373	165	252	2.33	2.60	15,000	A.
July	224	121	159	1.47	1.70	9,780	A.
August	167	69	119	1.10	1.27	7,320	A.
September	73	36	54.6	.506	.56	3,250	A.
October	36	13	19.6	.181	.21	1,210	A.
November	42	13	20.2	.187	.21	1,200	B.
December	17.4	8.6	9.87	.091	.10	607	C.
The year			67.0	.620	8.45	48,700	

NOTE.—Discharge estimated December 7, 1907, to February 4, 1908.

BOULDER CREEK NEAR BOULDER, COLO.

This station, which is located 1½ miles above the town of Boulder, in T. 1 N., R. 71 W., was established May 13, 1895, to determine the quantity of water available for irrigation and power development.

Records were also kept on this stream near Boulder from 1888 to 1892. From 1895 to 1901 the station was maintained in cooperation with the state engineer of Colorado. From 1902 to 1906 the records are published only in the reports of the state engineer of Colorado.

The station is at the mouth of Boulder Canyon, about 1½ miles below Fourmile Creek and some 20 miles above the confluence with the St. Vrain.

Two small irrigation ditches take water above the station, but their combined flow amounts to only a few second-feet. The municipal supply of Boulder is also taken out above the station.

This valley is quite broad and is practically all under irrigation, the entire normal flow of the stream being used for that purpose.

The upper portions of this creek and its tributaries flow through mountainous areas which are extensively timbered, although they have been deforested to a very considerable extent. The drainage area above the Boulder station is 129 square miles, and at the junction with the St. Vrain, 434 square miles.

The Eastern Colorado Power Company is now constructing a plant on Boulder Creek which will have a capacity of probably 20,000 horsepower. By making use of storage facilities it would be possible to develop at least 50,000 horsepower on this stream during six months of the year. The upper waters are now being used for placer mining and by small power plants which aggregate less than 1,000 horsepower. Sites for additional power filings no doubt exist.

As good measurements can not be made during high water at the bridge where the gage is located, an auxiliary gage was located at the Ninth Street Bridge in Boulder, and high-water measurements have since been made at this point. Between the two gages the Farmers' canal and the Anderson ditch are diverted and Sand Creek and Gregory Creek come in, so allowance is made for these in using the measurements made at the Ninth Street Bridge to obtain the discharge at the upper gage.

Boulder Creek, like other mountain streams in this part of Colorado, is frozen over wholly or partly for three or four months in the winter time. The natural flow is not at present greatly modified by reservoirs, but will be when some of the reservoirs now under construction are completed.

The gage was washed out during the flood on August 1, 1908, and was replaced on August 14 by another gage in practically the same location, but the datum of which was about 0.5 foot lower than that of the old gage. No other changes in the gage datum are on record since the station was established.

As the stream is very swift and the bed is composed of bowlders it is impossible to procure very accurate results during high water. At moderate and low stages very good measurements can be obtained.

Discharge measurements of Boulder Creek at Ninth Street Bridge, Boulder, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	W. B. Freeman	56	83	2.60	452
June 7	C. L. Chatfield	57	97	2.65	497
June 27	....do	59	101	2.70	500
July 29	W. B. Freeman	55	85	2.50	495
August 30	....do	38	40	1.80	97
September 26[a]	Freeman and Stewart	30	20.6	1.18	16.5
October 23[a]	J. B. Stewart	32	25.4	1.30	29.1
1908.					
April 22[a]	C. L. Chatfield	38	36	1.66	60
April 23[a]	....do	38	41	1.72	72
May 14	W. B. Freeman	37	32	1.50	40
June 18[a]	J. B. Stewart	52.5	75	2.17	214
June 27	....do	55	79	2.28	270
June 29	C. L. Chatfield	48	56	2.00	154
July 31	....do	46.5	58	2.02	146

[a] Made by wading.

Discharge measurements of Boulder Creek at state engineer's gage near Boulder, Colo., in 1907 and 1908.

Date.	Hydrographer.	Gage height.	Discharge.
1907.		*Feet.*	*Sec.-ft.*
May 20	W. B. Freeman	2.42	452
June 7	C. L. Chatfield	2.40	501
June 27	....do	2.40	548
July 29	W. B. Freeman	2.13	527
August 30	....do	1.28	128
September 26	Freeman and Stewart	.40	34
October 23	J. B. Stewart	.47	31
1908.			
April 16[a]	Thomas Grieve, jr	.23	14.5
April 22[a]	....do	.98	83
Do	C. L. Chatfield	.98	70.4
April 23	....do	1.05	82.4
May 12[a]	Thomas Grieve, jr	.90	77
May 14	W. B. Freeman	.85	65
June 12[a]	Thomas Grieve, jr	1.80	284
June 18[a]	J. B. Stewart	1.80	229
June 27	....do	1.90	303
June 29	C. L. Chatfield	1.52	182
July 15[a]	Thomas Grieve, jr	1.50	196
July 31	Stewart and Chatfield	1.55	184
August 14[a]	Thomas Grieve, jr	1.80	123
September 11[a]	....do	1.23	43
October 15[a]	....do	.78	19
November 21[a]	J. B. Stewart	.90	16.1
Do	....do	.90	17.5
December 8	C. L. Chatfield	[b]1.10	17.3
December 10	W. B. Freeman	.90	14

[a] Measured by wading at the gage. Other measurements have been computed from the measured discharge at the Ninth Street Bridge by adding the discharge of the two canals and deducting the inflow from Sand and Gregory creeks.

[b] Gage height affected by ice.

NOTE.—Measurements in 1907 were obtained by adding the total diversions between Ninth Street Bridge and this station to the measurements made at Ninth Street Bridge and subtracting the flow of Sand Creek. Measurements beginning August 14, 1908, are referred to a new gage at a different datum.

Daily gage height, in feet, of Boulder Creek at state engineer's gage near Boulder, Colo., for 1907 and 1908.

[Alva Sparks, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
1		1.50	2.02	2.75	1.98	1.05	0.58	0.52	0.55
2		1.35	2.15	2.85	1.95	1.18	.58	.42	.62
3		1.35	2.32	2.88	2.02	1.08	.48	.38	.65
4		1.35	2.20	2.82	1.88	.98	.38	.32	.62
5		1.38	2.35	2.82	1.82	1.02	.48	.32	.60
6		1.28	2.42	2.80	1.68	1.02	.42	.35	.50
7		1.35	2.40	2.72	1.62	.98	.42	.30	.50
8		1.52	2.45	2.55	1.70	.90	.45	.25	.48
9		1.65	2.30	2.55	1.68	.82	.52	.22	.45
10		1.75	2.32	2.52	1.62	.82	.45	.32	.42
11		1.80	2.32	2.42	1.52	.70	.38	.32	.38
12		1.98	2.38	2.32	1.55	.72	.45	.45	.42
13		1.98	2.42	2.35	1.55	.72	.45	.42	.45
14		1.92	2.55	2.55	1.40	.80	.40	.52	.45
15		1.90	2.52	2.50	1.58	.75	.48	.52	.32
16		1.92	2.52	2.35	1.58	.70	.48	.42	.38
17		2.02	2.58	2.10	1.40	.78	.48	.48	.35
18		2.10	2.68	1.95	1.40	.72	.42	.55	.42
19		2.28	2.58	2.05	1.42	.72	.38	.55	.32
20		2.42	2.50	2.02	1.42	.75	.42	.55	.30
21		2.42	2.42	2.02	1.38	.75	.45	.60	.25
22		2.40	2.50	2.00	1.28	.75	.48	.58	.45
23		2.40	2.52	2.18	1.08	.65	.50	.58	.62
24		2.40	2.60	2.18	1.08	.68	.48	.55	.65
25		2.32	2.68	2.38	1.08	.58	.38	.42	.62
26		2.02	2.62	2.58	1.12	.55	.42	.52	.52
27		1.85	2.65	2.45	1.18	.68	.42	.48	.52
28		1.88	2.65	2.45	1.22	.72	.45	.58	.50
29		1.85	2.58	2.32	1.28	.60	.42	.62	.48
30		1.90	2.70	2.18	1.32	.52	.48	.50	.45
31		1.85		2.08	1.20		.40		.42
1908.									
1	0.05	.6	1.45	1.5		1.4	1.05	.9	
2	.15	.8	1.5	1.55		1.35	.9	.9	
3	.15	1.05	1.55	1.5		1.3	.9	.8	
4	.1	.8	1.8	1.5		1.2	1.0	.85	
5	.1	.85	1.6	1.55		1.15	1.0	.85	
6	.2	.8	1.6	1.5		1.2	.9	.9	
7	.2	.9	1.6	1.5		1.3	.9	.85	
8	.2	1.1	1.55	1.5		1.2	.9	.9	
9	.2	1.25	1.7	1.5		1.15	.9	.9	
10	.25	1.0	1.75	1.45		1.2	.9	.8	
11	.45	1.0	1.85	1.5		1.2	.8	.8	
12	.55	.9	2.0	1.7		1.2	.9	.8	
13	.65	.9	2.0	1.6		1.3	.8	.8	
14	.75	.85	1.9	1.55		1.3	.8	.8	
15	.85	.85	2.0	1.5		1.4	.8	.9	
16	.9	1.1	2.0	1.5	1.8	1.35	.8	.95	
17	.85	1.2	2.05	1.4	1.8	1.3	.8	1.0	
18	.85	1.2	1.9	1.4	1.9	1.2	.8	.9	
19	.95	1.3	1.7	1.4	2.0	1.2	.8	.9	
20	.8	1.5	1.6	1.25	2.0	1.2	.8	.9	
21	.9	1.35	1.7	1.2	1.9	1.15	.75	.8	
22	1.05	1.3	1.75	1.2	2.0	1.2	1.0	.75	
23	1.05	1.2	1.65	1.2	1.9	1.2	.8	.8	
24	.8	1.45	1.7	1.2	1.8	1.15	.9	.75	
25	.75	1.45	1.8	1.2	1.8	1.2	.9	.9	
26	.65	1.3	1.7	1.25	1.7	1.2	.9	1.4	
27	.55	1.3	1.9	1.25	1.65	1.2	.95		
28	.55	1.15	1.7	1.2	1.55	1.2	.8		
29	.5	1.2	1.6	1.2	1.5	1.2	.9		
30	.55	1.3	1.6	1.6	1.4	1.1	.9		
31		1.3		1.55	1.4		.9		

NOTE.—The gage was more or less affected by ice conditions in the latter part of November and during December, 1907; also, after November 25, 1908. Gage was washed out during period August 1–15, 1908. Gage heights beginning August 16, 1908, refer to a new gage installed at a different datum. The new gage heights are not comparable with the old.

Rating tables for Boulder Creek at state engineer's gage near Boulder, Colo.

MAY 1, 1907, TO JULY 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	5	0.80	58	1.60	206	2.40	550
.10	8	.90	70	1.70	238	2.50	606
.20	12	1.00	83	1.80	273	2.60	664
.30	18	1.10	97	1.90	312	2.70	725
.40	25	1.20	114	2.00	353	2.80	788
.50	32	1.30	133	2.10	398	2.90	853
.60	39	1.40	154	2.20	446	3.00	920
.70	48	1.50	178	2.30	497		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seventeen discharge measurements made during 1907 and 1908, and is fairly well defined below gage height, 2.0 feet.

AUGUST 16 TO DECEMBER 31, 1908.

0.70	13	1.10	32	1.50	74	1.90	145
.80	15	1.20	40	1.60	89	2.00	170
.90	18	1.30	50	1.70	105		
1.00	24	1.40	61	1.80	123		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period, and is not well defined.

Monthly discharge of Boulder Creek at state engineer's gage near Boulder, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May	561	129	322	19,800	A.
June	725	362	589	35,000	B.
July	840	332	565	34,700	B.
August	362	94	186	11,400	A.
September	111	33	59.0	3,510	A.
October	38	24	28.5	1,750	B.
November 1–17	33	13	23.8	803	C.
The period				107,000	
1908.					
April	90	6	40.2	2,390	A.
May	178	39	103	6,330	A.
June	374	166	256	15,200	A.
July	238	114	161	9,900	A.
August 16–31		61	120	3,810	A.
September	61	32	43.3	2,580	B.
October	28	14	17.8	1,090	B.
November	24	14	17.0	1,010	C.
December			13.4	824	D.
The period				43,100	

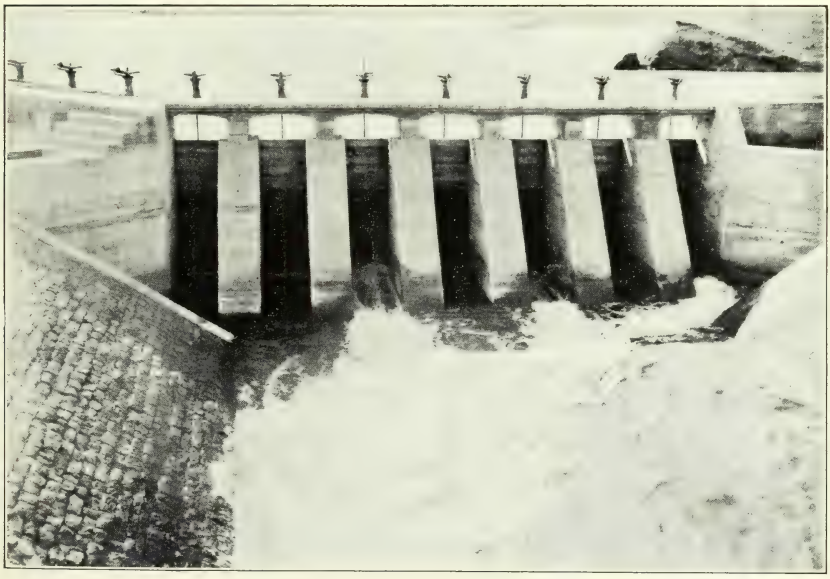
NOTE.—Daily discharge estimated from November 26 to December 31, 1908.

KANSAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Kansas River lies between the basins of the Platte and the Arkansas, entirely within the region of the Great Plains. The Kansas as such is a comparatively short stream, being formed by the union of Smoky Hill and Republican rivers in Geary

A. DIVERSION DAM, BELLE FOURCHE PROJECT, SOUTH DAKOTA.



B. DIVERSION DAM AND HEAD-GATES, BELLE FOURCHE PROJECT, SOUTH DAKOTA.

County, Kans., whence it flows eastward, entering the Missouri at Kansas City, Mo.

The Smoky Hill rises near the boundary between Kansas and Colorado, pursues a winding but on the whole easterly course through Kansas, and near Junction unites with the Republican. Its length is 335 miles, and the extreme width of its basin is about 100 miles. The river runs close to the northern border of the Arkansas basin, and its chief tributaries are from the north. Solomon and Saline rivers are the most important, the former draining the northern part of Kansas and the latter the territory between the Solomon and the Smoky Hill.

Republican River rises in the arid plains of eastern Colorado, flows northeastward into southwestern Nebraska, then eastward through the southern tier of counties to Superior, where it turns to the southeast, enters Kansas, and finally joins the Smoky Hill. The length of the basin east and west is approximately 360 miles, its greatest width is 120 miles, and the total area drained is 25,840 square miles. The river is wide and rather shallow, with a rapid descent, and the bed is largely shifting quicksand of the most unstable character. In its upper course the Republican receives many tributaries, chiefly from the south. Nearly all of these flow through a region where the rainfall is less than 22 inches, but as this part of the basin is covered with buffalo grass, which sheds rain like a roof, the per cent of rainfall reaching the streams is great. Near the mouth the drainage area is very narrow and the tributaries are small and unimportant, but here the rainfall is 28 to 30 inches a year. Many small springs are found along the main stream and its branches, and the ground water generally lies at medium depth. The soil of the middle part of the basin is porous, sandy loam, and about 55 per cent of the land is under cultivation; along the lower course the soil is black loam and clay, and about 75 per cent of the land is cultivated. The rainfall in the lower basin is considered sufficient for all growing crops. The Republican is subject to sudden rises and falls, and occasionally overflows its banks.

The most important feeder of the Kansas below the junction of the Smoky Hill and Republican rivers is the Blue, which rises in southeastern Nebraska, flows to the southeast and south into Kansas, and joins Kansas River at Manhattan. The principal tributary of the Blue is the Little Blue, which rises in southern Nebraska, flows southeastward, and unites with the main stream near Blue Rapids.

The basin of the Kansas comprises the richest portion of the State of Kansas, consists of bottoms and rolling uplands, well timbered with oak, cottonwood, ash, elm, hickory, etc. The section is under a high state of cultivation and produces a great variety of crops. The river flows through a rich alluvial bottom land. The banks are

sandy and easily cave in. In places the bed contains rock and bowlders, but in general it is composed of sand and at many points of quicksand. The channel as a rule hugs one bank or the other and is somewhat shifting. Islands are formed here and there by the deposit of sediment during high water, drift lodges upon them, and a thick growth of brush, mainly cottonwood, soon springs up. At Topeka the river is 900 feet wide between banks. At ordinary low water the channel occupies 150 to 200 feet of this width and has a depth of 8 to 9 feet; at mean high water the average depth is probably 10 feet for the entire distance between banks.

The following gaging stations have been maintained in the Kansas basin:

North Fork of Republican River near Benkelman, Nebr., 1895.
Republican River at Benkelman, Nebr., 1903–1906.
Republican River at Bostwick, Nebr., 1904–1908.
Republican River near Superior, Nebr., 1896–1903.
Republican River at Junction, Kans., 1895–1905.
Kansas River near St. George, Kans., 1904.
Kansas River near Topeka, Kans., 1904.
Kansas River near Lecompton, Kans., 1899–1901, 1903–1906.
Kansas River near Lawrence, Kans., 1895–1899.
South Fork of Republican River at Benkelman, Nebr., 1895, 1903–1906.
Frenchman River near Wauneta, Nebr., 1895.
Frenchman River near Palisade, Nebr., 1895–96.
Smoky Hill River at Ellsworth, Kans., 1895–1902, 1904–5.
Smoky Hill River at Solomon, Kans., 1902–1904.
Saline River near Salina, Kans., 1895–1903.
Solomon River near Niles, Kans., 1895–1903.
Blue River at Manhattan, Kans., 1895–1905.
Little Blue River near Fairbury, Nebr., 1908.

REPUBLICAN RIVER AT BOSTWICK, NEBR.

This station, which is located at a highway bridge 1 mile southwest of Bostwick, Nebr., in sec. 23, T. 1 N., R. 8 W., was established June 6, 1904, to replace the station at Superior, Nebr., which had been maintained from 1896 to 1903. Records at this point show the amount of water carried by the river at the Nebraska-Kansas state line, and are of value in connection with irrigation above and flood control below.

No records have been obtained during the winter period. No storage is used on the stream to reduce floods or to reenforce the low-water flow, so that the variation in discharge is great. Owing to the unstable condition of the stream bed the records are more or less unsatisfactory.

The gage has remained the same since the establishment of the station.

Discharge measurements of Republican River at Bostwick, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1907.					
April 2	Arthur Dobson	259	380	1.46	570
June 12	do	406	550	2.05	991
July 9	do	296	185	1.05	243
August 13	do	210	80	.75	106
September 10	do	146	69	.65	106
October 31	do	130	72	.90	139
1908.					
March 13	F. S. Dobson	354	321	1.45	544
April 25	Arthur Dobson	234	148	1.05	230
May 12	G. W. Bates	368	383	1.80	749
June 5	Arthur Dobson	315	662	2.72	1,480
June 23	do	414	998	3.62	2,390
July 15	do	336	345	2.15	894
August 29	G. W. Bates	401	531	2.34	1,020
September 15	A. A. Dobson	200	124	.92	174
October 23	do	418	1,460	4.79	4,320
November 28	do	222	324	1.55	597

Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1907 and 1908.

[J. W. Keife, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1			1.35	1.65	1.5	0.95	0.6	1.2	0.95	1.25
2		1.45	1.35	1.5	1.4	.9	.6	1.2	.9	1.25
3		1.45	1.4	1.5	1.5	.85	.5	.9	.9	1.25
4		1.45	1.4	1.4	1.45	.85	.9	.65	.95	1.3
5		1.45		1.4	1.3	.85	.9	.6	.95	1.25
6		1.45	1.4	1.35	1.25	.8	.95	.5	.95	1.25
7			1.45	2.15	1.15	.75	.9	.5	.95	1.3
8		1.45	1.4	3.1	1.1	1.0	.7	.55	.95	1.25
9		1.4	1.45	2.1	1.05	.85	.65	.7	.9	1.2
10		1.4	1.45	2.2	1.0	.75	.65	.7	.9	1.2
11		1.4	1.4	2.45	.95	.7	.65	.65	.95	1.25
12		1.35		2.1	1.15	.7	.6	.6	.95	1.3
13		1.35	1.4	1.8	.95	.7	.6		.95	1.3
14		1.35	1.4	2.0	1.3	.75	.55	.65	.95	1.2
15		1.35	1.35	1.65	2.35	.7	.55	.7	.9	
16		1.35	1.3	1.5	1.6	.7	.55	.7	.9	
17		1.35	1.3	1.4	1.65	.65	.5	.75	.95	
18		1.3	1.3	1.45	2.25	.65	.5	.7	.95	
19		1.35	1.45	1.6	1.35		.4	.7	1.0	
20		1.35	1.35	1.4	1.25		.35	.7	1.2	
21		1.35	1.2	1.3	.95		.35	.75	1.1	
22		1.3	1.2	1.35	1.75	.95		.8	1.15	
23		1.35	1.15	2.1	1.6	1.0	.3	.8	1.3	
24		1.35	1.15	1.4	1.6	.9	.3	.85		
25		1.3	1.15	1.45	1.45	.8	.3	.8	1.3	
26		1.35	1.1	1.7	1.4	.75	.3	.8	1.3	
27		1.4	2.65	1.4	1.25	.7	.55	.8	1.3	
28		1.4	2.55	1.4	1.2	.75	.4	.8	1.3	
29		1.4	2.1	1.4	1.1	.7		.85	1.25	
30		1.4	1.85	1.65	1.05	.7	.6	.85	1.25	
31			1.8		.95	.6		.85		
1908.										
1	1.75	1.35	.95	1.0	1.75	1.4	1.75	.75	1.85	1.7
2	1.65	1.35	.95	3.2	1.7	1.3	1.65	.7	1.7	1.65
3	1.6	1.25	.95	1.8	1.7	1.25	1.55	.7	1.7	1.55
4	1.55	1.25	1.0	1.5	1.8	1.2	1.45		1.6	1.75
5	1.55		1.0	2.7	1.5	1.05	1.55	.7	1.65	1.65
6	1.55	1.35	1.0	2.05	1.4	1.0	1.25	.8	1.6	
7	1.5	1.3	1.0	2.55	3.05	1.1	1.2	.7	1.6	2.75
8	1.5	1.25	1.05	1.8	2.0	1.15	1.15	.7		2.7
9	1.45	1.2	1.05	1.65	1.55	1.2	1.15	.7	1.5	2.7
10	1.4	1.2	1.05	2.15	1.4	1.4	1.15	1.25	1.5	2.7

Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
11	1.45	1.2	1.15	2.5	1.85	2.2	1.1	1.1	1.5	2.7
12	1.45	1.2	1.65	3.6	2.05	2.45	1.0	1.0	1.45	2.85
13	1.45	1.15	1.25	3.5	2.85	1.45	1.0	.9	1.45	.....
14	1.4	1.1	2.55	.....	2.35	1.05	.95	.9	1.45	2.7
15	.....	1.1	1.8	2.05	2.15	.95	.9	.9	.....	2.55
16	1.4	1.1	1.3	3.6	2.15	1.85	.9	.85	1.45	2.4
17	1.35	1.15	1.2	3.9	1.45	1.95	.9	.85	1.55	1.85
18	1.35	1.15	1.2	6.3	1.95	1.3	.85	.....	1.55	1.75
19	1.35	.....	1.3	4.3	2.5	3.5	.85	.85	1.55	3.1
20	1.35	1.1	1.4	4.65	2.5	4.9	.....	.9	1.5	4.05
21	1.35	1.1	1.25	3.8	2.35	2.3	.7	.9	1.45	4.9
22	.....	1.1	1.15	2.9	2.05	4.4	.7	.9	1.55	4.8
23	1.35	1.1	1.1	3.4	3.6	3.6	.7	4.8	1.6	4.8
24	1.3	1.05	.....	3.5	2.95	2.9	.65	3.55	1.55	4.8
25	1.3	1.05	1.1	2.45	1.85	2.5	.65	.....	1.5	4.8
26	1.3	1.0	1.1	2.15	1.6	2.15	.65	2.6	1.5	4.75
27	1.3	1.0	1.1	2.2	2.5	2.2	.....	2.3	1.55	.....
28	1.3	1.0	1.85	1.85	2.0	1.85	.85	2.1	1.55	3.95
29	1.3	.95	1.35	1.65	1.7	2.3	.75	2.05	.....	3.9
30	1.3	.95	1.3	1.6	1.65	2.4	.75	1.9	1.65	3.85
31	1.3	.....	1.2	.....	1.5	2.0	.....	1.85	.....	3.8

NOTE.—Ice conditions about December 15, 1907, to February 29, 1908, and probably after December 6, 1908.

Rating tables for Republican River at Bostwick, Nebr.

APRIL 2 TO MAY 26, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	335	1.30	460	1.40	530	1.50	600
1.20	395						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of the preceding curve, and is fairly well defined.

MAY 27, 1907, TO MAY 15, 1908, AND SEPTEMBER 14 TO DECEMBER 31, 1908.

0.30	40	1.40	445	2.50	1,430	3.60	2,730
.40	50	1.50	520	2.60	1,540	3.70	2,860
.50	60	1.60	600	2.70	1,650	3.80	2,990
.60	75	1.70	680	2.80	1,760	3.90	3,120
.70	100	1.80	760	2.90	1,880	4.00	3,250
.80	130	1.90	850	3.00	2,000	4.20	3,510
.90	165	2.00	940	3.10	2,120	4.40	3,790
1.00	205	2.10	1,030	3.20	2,240	4.60	4,070
1.10	255	2.20	1,130	3.30	2,360	4.80	4,350
1.20	310	2.30	1,230	3.40	2,480	5.00	4,630
1.30	375	2.40	1,330	3.50	2,600		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the first period and three made during the last, and is fairly well defined between gage heights 0.5 foot and 2.5 feet.

MAY 16 TO JUNE 2, 1908, AND SEPTEMBER 1 TO SEPTEMBER 13, 1908.

[Daily discharges obtained by the indirect method for shifting channels.]

JUNE 3 TO AUGUST 31, 1908.

0.90	65	2.00	730	3.10	1,850	4.40	3,460
1.00	95	2.10	810	3.20	1,960	4.60	3,720
1.10	130	2.20	895	3.30	2,080	4.80	3,990
1.20	170	2.30	990	3.40	2,200	5.00	4,270
1.30	220	2.40	1,095	3.50	2,320	5.20	4,550
1.40	280	2.50	1,200	3.60	2,440	5.40	4,830
1.50	345	2.60	1,305	3.70	2,560	5.60	5,110
1.60	415	2.70	1,410	3.80	2,680	5.80	5,410
1.70	490	2.80	1,520	3.90	2,810	6.00	5,710
1.80	570	2.90	1,630	4.00	2,940	6.20	6,010
1.90	650	3.00	1,740	4.20	3,200	6.40	6,310

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and the form of the preceding curve, and is well defined between gage heights 2.0 feet and 3.7 feet.

Daily discharge, in second-feet, of Republican River at Bostwick, Nebr., May 16 to June 2 and September 1 to September 13, 1908.

Day.	May.	June.	Sept.	Day.	May.	June.	Sept.	Day.	May.	June.	Sept.
1		200	560	11			210	21	320		
2		2,050	485	12			165	22	240		
3			420	13			165	23	215		
4			350	14				24	215		
5			440	15				25	215		
6			260	16	350			26	215		
7			235	17	290			27	215		
8			205	18	290			28	680		
9			205	19	350			29	320		
10			230	20	420			30	290		
								31	240		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Republican River at Bostwick, Nebr., for 1907 and 1908.

[Drainage area, 23,300 square miles.]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	565	460	518	30,800	C.
May	1,600	335	590	36,300	C.
June	2,120	375	699	41,600	B.
July	1,280	185	435	26,700	B.
August	205	75	123	7,560	D.
September	185	40	77.5	4,610	D.
October	310	68	122	7,500	D.
November	375	165	240	14,300	D.
December 1–14	375	310	345	9,580	C.
The period				179,000	
1908.					
March	720	375	460	28,300	C.
April	410	185	287	17,100	C.
May	1,480	185	337	20,700	C.
June	6,160	200	1,620	96,400	B.
July	2,440	280	812	49,900	B.
August	4,130	80	878	54,000	B.
September	560	88	203	12,100	D.
October	4,350	100	609	37,400	B.
November	805	482	546	32,500	B.
December			680	41,800	D.
The period				390,000	

NOTE.—Discharge estimated August 19–21 and November 24, 1907, and for days in 1908 for which gage heights are missing.

LITTLE BLUE RIVER NEAR FAIRBURY, NEBR.

This station, which is located at the highway bridge 1½ miles south of Fairbury and about 12 miles above the Nebraska-Kansas state line, was established May 23, 1908, to obtain data for use in studies of run-off and flood control and in power development.

Sandy Creek, the principal tributary, enters about 10 miles above. Muddy Creek, a small stream, is the only tributary between the station and the Kansas line.

The dam of the Fairbury Roller Mill is about 2 miles above the station, and may possibly cause some daily fluctuation in stage.

Gage heights are apparently little affected by ice.

Records have been fairly satisfactory, though the channel shifts at high stages. The maximum discharges are somewhat uncertain as the river overflows its banks at about 11 feet gage height. The amount of overflow has been estimated.

Discharge measurements of Little Blue River near Fairbury, Nebr., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 23	G. W. Bates	85	144	2.33	208
June 3	do	356	2,590	11.34	7,240
Do	Adna Dobson			12.52	[a] 10,100
June 20	Arthur Dobson	320	1,920	9.87	3,420
July 3	do	197	863	6.28	1,230
July 16	do	240	1,100	7.34	1,940
August 29	G. W. Bates	135	377	4.75	536
September 15	Arthur Dobson	120	118	3.20	218
October 2	do	70	105	2.90	189
November 19	do	70	100	2.90	175
December 12	do	70	99	2.97	194

[a] Estimated overflow was 1,760 second-feet.

Daily gage height, in feet, of Little Blue River near Fairbury, Nebr., for 1908.

[Fred F. Borland, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.25	5.1	4.35	4.2	2.9	2.9	2.85
2		9.95	4.8	4.1	4.0	2.85	2.9	2.8
3		11.9	6.4	3.9	3.8	2.85	2.9	2.75
4		10.3	5.0	3.75	3.75	2.85	2.85	3.05
5		12.3	4.6	4.9	3.7	2.9	2.9	3.0
6		13.9	6.6	3.45	3.45	2.9	2.9	2.95
7		13.9	8.1	3.3	3.4	2.95	2.9	2.9
8			6.1	3.5	3.5	3.0	2.85	2.85
9			7.45	3.45	3.35	3.0	2.85	2.9
10		12.5	5.9	3.4	3.35	2.8	2.85	2.95
11		8.3	5.1	3.5	3.25	2.9	2.8	3.0
12		9.4	4.75	3.5	3.2	2.85	2.8	3.6
13		11.4	9.25	3.9	3.2	2.85	2.8	3.8
14		10.2	11.7	4.7	3.2	2.85	2.8	2.9
15		9.8	11.15	4.2	3.2	2.85	2.8	2.9
16		7.8	7.65	3.8	3.25	2.85	2.85	2.9
17		11.5	5.4	4.4	3.1	2.85	2.9	2.9
18		7.6	4.7	3.75	3.1	2.85	2.9	2.9
19		12.6	4.55	4.95	3.05	2.9	2.9	2.9
20		10.2	4.3	11.8	3.05	2.9	2.9	2.9
21		8.6	8.5	12.9	3.0	2.9	2.9	2.9
22		7.0	4.9	10.6	2.95	2.9	2.9	2.9
23	2.3	7.0	8.6	9.8	2.9	2.95	2.9	2.85
24	2.3	9.5	8.9	6.4	2.9	2.9	2.9	2.85
25	2.3	8.35	9.2	5.9	2.85	2.9	2.9	2.85
26	2.5	7.75	6.8	5.3	3.05	2.9	2.9	2.8
27	2.3	7.1	5.9	5.5	3.0	2.9	2.9	2.85
28	8.05	11.4	5.55	5.15	2.9	2.9	2.9	2.85
29	11.1	6.9	4.8	4.75	2.9	2.9	3.0	2.45
30	6.05	5.4	4.4	4.5	2.9	2.9	3.0	2.65
31	4.9		4.5	4.25		2.9		2.75

NOTE.—The observer made no statement concerning possible ice conditions.

Rating tables for Little Blue River near Fairbury, Nebr.

MAY 29 TO JUNE 10, 1908, AND JUNE 28 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	130	3.90	330	5.40	810	7.80	2,300
2.50	140	4.00	350	5.50	850	8.00	2,480
2.60	150	4.10	375	5.60	890	8.20	2,660
2.70	160	4.20	400	5.70	940	8.40	2,840
2.80	170	4.30	425	5.80	990	8.60	3,030
2.90	180	4.40	450	5.90	1,040	8.80	3,230
3.00	190	4.50	480	6.00	1,090	9.00	3,430
3.10	200	4.60	510	6.20	1,190	10.00	4,690
3.20	210	4.70	540	6.40	1,310	11.00	6,520
3.30	225	4.80	575	6.60	1,430	12.00	8,800
3.40	240	4.90	610	6.80	1,560	13.00	11,340
3.50	255	5.00	650	7.00	1,700	14.00	13,980
3.60	270	5.10	690	7.20	1,840		
3.70	290	5.20	730	7.40	1,980		
3.80	310	5.30	770	7.60	2,140		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the periods and one estimated measurement. It is well defined between gage heights 2.9 feet and 7.5 feet. Above gage height 7.5 feet it is fairly well defined.

MAY 23–28 AND JUNE 11–27, 1908.

[Daily discharges obtained by the indirect method for shifting channels.]

Daily discharge, in second-feet, of Little Blue River near Fairbury, Nebr., for 1908.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1			11		2,600	21		2,200
2			12		3,600	22		1,100
3			13		6,700	23	205	1,100
4			14		4,400	24	205	3,000
5			15		3,800	25	205	2,000
6			16		1,850	26	235	1,600
7			17		6,250	27	205	1,150
8			18		1,600	28	3,100	
9			19		8,300	29		
10			20		3,750	30		
						31		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Blue River near Fairbury, Nebr., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 23–31	6,730	205	1,400	25,000	D.
June	13,700	412	5,140	306,000	D.
July	8,080	425	1,770	109,000	A.
August	11,100	225	1,370	84,200	A.
September	400	175	225	13,400	A.
October	190	170	179	11,000	B.
November	190	170	178	10,600	B.
December	310	135	184	11,300	B.
The period				570,000	

GASCONADE RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of the Gasconade lies in the south-central part of Missouri. The river is formed by Piney, Lock, and Osage forks and Roubidoux Creek, which rise in southern Missouri and flow northward to unite in Laclede and Pulaski counties. From the junction of the forks to the point where the Gasconade enters the Missouri the distance by general course is about 60 miles, but including the windings it is probably more than 100 miles. The total area of the basin is about 3,500 square miles.

The headwater region comprises an area of regular outline, about 65 miles long by 45 miles wide, forming part of an elevated tableland belonging to the Ozark range of hills, and along the streams the surface is very rough and broken. The lower part of the basin, below Arlington, is long and narrow, its average width for a distance of about 55 miles being less than 15 miles. Below Vienna the valley averages about half a mile in width and is bordered by bluffs 100 to 200 feet high. Throughout the lower section the river flows in a succession of shoals and pools. On the shoals the stream bed is usually gravel, but the pools contain considerable deposits of sand and mud. Depth to rock beneath the stream bed is estimated at 10 to 30 feet. The rocks along the stream are chiefly limestone and sandstone.

The sources of the river are from 1,400 to 1,600 feet above sea level. At Arlington the elevation is about 650 feet and at the mouth of the river it is about 490 feet above the sea.

Above the junction of the forks the drainage basin is partly forested, but below that point it may be considered a deforested region. The mean annual rainfall is about 40 inches. The winters are mild. Facilities for storage have not been investigated.

The basin contains a great number of springs, some of those in the upper part being very large, and these springs help to maintain the low-season flow of the river. The streams offer fair opportunities for power development. As the main river is very crooked, it may be possible in some localities to shorten it by cutting across the narrow necks and to utilize the fall thus developed. Some of the tributaries may offer sites with good heads, as the slope of the tributaries is much greater than that of the main stream.

The Gasconade is subject to sudden floods, reaching approximately 25 feet above low water.

The following gaging stations have been maintained in this basin:

Gasconade River at Arlington, Mo., 1903 to 1906.
Piney Fork of Gasconade near Houston, Mo., 1908.
Piney Fork of Gasconade (also called Big Piney Creek) near Hooker, Mo., 1903.
Little Piney Creek near Arlington, Mo., 1903.

PINEY FORK OF GASCONADE RIVER NEAR HOUSTON, MO.

This station, which is located about 3½ miles northwest of Houston, Mo., was established October 7, 1908, to obtain data for use in connection with water-power development.

Brushy Creek enters about 200 feet above the station. The low-water flow is modified by a power plant a short distance above the station. Measurements are made by means of a boat and cable or by wading in low water.

The datum of the chain gage, which is located 50 feet below the measuring section, has remained unchanged.

The following discharge measurement was made by wading October 7, 1908:

Width, 25.5 feet; area, 19 square feet; gage height, 4.87 feet; discharge, 19 second-feet.

Daily gage height, in feet, of Piney Fork of Gasconade River near Houston, Mo., for 1908.

[W. A. Stewart, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	5.00	5.64	11	5.02	5.02	5.08	21	5.18	5.12	.....
2	.....	4.99	5.59	12	4.91	5.02	5.06	22	5.24	5.08	5.07
3	.....	5.01	5.35	13	4.90	5.01	.....	23	5.03	5.08	5.06
4	.....	5.04	5.32	14	4.84	.....	.....	24	5.04	5.08	5.06
5	.....	5.08	5.30	15	4.93	5.00	.....	25	4.82	5.08	5.05
6	4.89	.....	.....	16	4.94	4.92	5.04	26	5.00	5.09	.....
7	4.93	.....	5.25	17	4.92	4.98	5.02	27	4.86	5.14	5.08
8	4.88	5.01	5.24	18	4.91	4.99	5.05	28	5.15	5.30	.....
9	4.85	5.04	5.20	19	5.40	5.13	5.18	29	5.05	5.44	5.03
10	4.82	5.02	5.18	20	5.02	5.00	.....	30	5.04	5.62	5.06
								31	.....	.....	5.06

NOTE.—Probably no ice conditions in December.

MISCELLANEOUS MEASUREMENTS.

The miscellaneous measurements made in the Missouri River basin in 1907 and 1908 are presented in the following pages. They have been listed under drainage basins in the same order as the regular stations.

Miscellaneous measurements in Missouri River basin.

UPPER MISSOURI BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1908.				*Feet.*	*Sec.-ft.*
May 5	Springs	Dearborn River	Clemons, Mont.	.....	10
August 29	Antoin-Lapieve ditch.	Smith Creek, Sun River.	Nixon's ranch, near Augusta, Mont.	.....	6.5
August 31	Willow Creek	Teton River, Marias River.	Belleview, Mont.	.....	7.9

Miscellaneous measurements in Missouri River basin—Continued.

YELLOWSTONE RIVER BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1908.				*Feet.*	*Sec.-ft.*
October 9	Boulder Creek	Yellowstone River	Contact, Mont		152
June 9	do	do	McLeod, Mont		1,260
October 29	Powder River	do	Powder River, Wyo., on C. N. W. R. R.		a 1
November 8	do	do	do		a .5

BIGHORN RIVER BASIN.

1908.					
November 3	Big Wind River	Bighorn River	Speed Stagner's ranch, Wyo.	2.73	579
December 10	do	do	do	.80	370
December 15	Dinwoodie Creek	Big Wind River	Crowheart, Wyo	1.20	a 35
November 2	Dry Creek	do	Above head of Dry Creek ditch, near Crowheart, Wyo.		b 24.2
Do	do	do	Crowheart, Wyo		23.4
December 14	do	do	do	3.10	a 12
November 2	Meadow Creek	do	J. K. Ranch, Wyo		13.5
December 14	do	do	do	2.00	10
November 2	Willow Creek	do	do		15.6
December 18	do	do	do	1.50	a 12
November 3	Bull Lake Creek	do	do	1.37	119
December 10	do	do	do	.95	40
August 24	Wyoming Central Irrigation Co. canal.	do	Riverton, Wyo		a 30
November 1	Sage Creek	Little Wind River	10 miles north of Fort Washakie, Wyo.		a 8
October 30	Trout Creek	do	Wind River, Wyo		a 12
December 22	do	do	do	2.40	9.6
October 19	Wyoming Central Irrigation Co. canal.	Big Wind River	Riverton, Wyo		a 10
November 7	Popo Agie River	Little Wind River	Above sinks 10 miles above Lander, Wyo.		45
Do	do	do	Below sinks 10 miles above Lander, Wyo.		60
1907.					
August 26	Popo Agie River	Little Wind River	Hudson, Wyo	c—13.20	389
October 20	do	do	do	c—13.70	142
1908.					
June 13	Popo Agie River	Little Wind River	Hudson, Wyo	c—11.45	2,090
July 26	do	do	do	c—13.28	451
August 25	do	do	do	c—13.30	401
November 5	do	do	do	c—13.54	
1907.					
October 21	Popo Agie River	Little Wind River	Arapahoe, Wyo		151
1908.					
November 6	Popo Agie River	Little Wind River	Arapahoe, Wyo		204
June 14	Baldwin Creek	Popo Agie River	Lander, Wyo		82
October 30	do	do	do		a 8
June 14	Squaw Creek	do	do		a 5
October 30	do	do	do		a 3
Do	North Fork of Popo Agie River.	do	Milford, Wyo		a 50
August 24	do	do	Lander, Wyo	d—4.85	164
Do	do	do	do	d—4.85	169
June 14	Little Popo Agie River.	do	5 miles above Hudson, Wyo.		395
April 20	North Fork of Shoshone River.	Shoshone River	Marquette, Wyo		1,620

a Estimated.
b Float measurement.
c Distance down from reference mark on W. N. W. R. R. bridge near Hudson just below mouth of Little Popo Agie. This reference mark is black cross, painted on NE. corner of cast-iron shoe at foot of first tier of tension rods from right abutment, downstream side of bridge.
d Distance down from reference mark, which is nail driven into stringer on downstream side of bridge, 7 feet from left abutment. This bridge is 3½ miles north of Lander.

Miscellaneous measurements in Missouri River basin—Continued.

HEART RIVER BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1907.					
July 21	Heart River	Missouri River	Mandan, N. Dak		205
July 25	do	do	do		534
1908.					
August 8	Heart River	Missouri River	"Big Bend" sec. 29, T. 136 N., R. 84 W., N. Dak.		17.1
August 9	do	do	Mandan, N. Dak		25.9
August 5	Little Heart River	do	Little Heart, sec. 15, T. 137 N., R. 81 W., N. Dak.		.16

CANNON BALL RIVER BASIN.

1908.					
August 17	North Fork of Cannon Ball River.	Cannon Ball River	New England, N. Dak.		0.3
May 8	do	do	Mott, N. Dak		6.55
August 5	Dogtooth Creek	do	Bridge, north of Stevenson, N. Dak.		.40

WHITE RIVER.

1908.					
July 19	White River	Missouri River	Sec. 35, T. 34 N., R. 48 W., Nebraska.		14.0
July 8	do	do	Sec. 7, T. 34 N., R. 47 W., Nebraska.		99.1
June 10	Ash Creek	White River	Sec. 12, T. 32 N., R. 51 W., Nebraska.		15.0
June 14	do	do	do		47.8
June 15	Dead Horse Creek	do	Sec. 32, T. 32 N., R. 49 W., Nebraska.		2.70
June 14	Indian Creek	do	Sec. 28, T. 32 N., R. 50 W., Nebraska.		1.46
Do	East Fork of Indian Creek.	Indian Creek	do		1.22
Do	West Fork of Indian Creek.	do	do		.42
June 19	Chadron Creek	White River	Sec. 12, T. 32 N., R. 49 W., Nebraska.		3.79
June 30	Big Bordeaux Creek	do	Sec. 11, T. 32 N., R. 48 W., Nebraska.		.19
July 25	do	do	Sec. 23, T. 33 N., R. 48 W., Nebraska.		5.97
July 17	do	do	Sec. 21, T. 34 N., R. 48 W., Nebraska.		6.77
June 26	Little Bordeaux Creek	Big Bordeaux Creek	Sec. 29, T. 33 N., R. 47 W., Nebraska.		2.17
July 3	Beaver Creek	White River	Sec. 4, T. 33 N., R. 46 W., Nebraska.		1.65
July 8	do	do	Sec. 34, T. 35 N., R. 47 W., Nebraska.		1.45

NIOBRARA RIVER BASIN.

1908.					
May 16	Eagle Creek	Niobrara River	¼ mile above mouth, sec. 1, T. 32 N., R. 11 W., Nebr.		64
Do	Red Bird Creek	do	½ mile above mouth, sec. 11, T. 32 N., R. 10 W., Nebr.		45
September 9	Verdigris Creek	do	Verdigris, Nebr		56
May 17	do	do	Niobrara, Nebr		138

Miscellaneous measurements in Missouri River basin—Continued.

MINOR MISSOURI RIVER DRAINAGE, IN NEBRASKA.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
May 16	Ponca Creek	Missouri River	Lynch, Nebr.		291
September 9	do	do	do		10
Do	do	do	Spencer, Nebr.		6.5
September 10	Bazile Creek	do	Creighton, Nebr.		6.3
May 16	do	do	Niobrara, Nebr.		97
May 11	Weeping Water Creek	do	Nehawka, Nebr.		38

NORTH PLATTE.

1908.					
November 20	North Platte	Platte River	Bridgeport, Nebr.		1,070
October 29	Casper Creek	North Platte	Casper, Wyo.		0
Do	Big Muddy Creek	do	Big Muddy, Wyo.		a 1
Do	Deer Creek	do	Glenrock, Wyo.		a 10
Do	Box Elder Creek	do	Careyhurst, Wyo		a 8
November 8	La Prele Creek	do	Fetterman, Wyo.		a 6
October 29	do	do	Douglas, Wyo.		a 3
Do	Chugwater Creek	Laramie River	Diamond, Wyo.		a 5
1907.					
October 18	Chugwater Creek	Laramie River	Chugwater, Wyo.		a 15

PLATTE RIVER BASIN.

1908.					
April 20	Platte River	Missouri River	Fremont, Nebr.		4,540
September 11	North Fork of Elkhorn River.	Elkhorn River	Pierce, Nebr.		46
Do	do	do	Norfolk, Nebr.		85
October 16	Oak Creek	Salt Creek	West line of sec. 16, T. 10 N., R. 6 E., Nebr.		51.3
November 24	do	do	North line of sec. 17, T. 10 N., R. 6 E., Nebr.		72
1907.					
May 16	Wahoo Creek	Salt Creek	Ashland, Nebr.		64
Do	do	do	do		72

SOUTH PLATTE.

1908.					
June 10	South Platte River	Platte River	Fort Morgan, Colo.		a 8
Do	do	do	Union, Colo.	0.70	90
July 21	do	do	do	.90	155
1907.					
April 4	South Platte River	Platte River	North Platte, Nebr.		0
July 16	do	do	do		a 200
1908.					
June 2	South Platte River	Platte River	North Platte, Nebr.		95
September 16	do	do	do		0
Do	North Fork of South Platte River.	South Platte River	Above mouth of Geneva Creek at Grant, Colo.		38
July 5	do	do	do		33
September 5	do	do	do		13
October 27	do	do	do		15.6
December 15	do	do	do		5.1
December 17	do	do	South Platte, Colo.		40
June 7	Geneva Creek	North Fork of South Platte River.	Geneva Park, Colo.		52
July 5	do	do	do		42
June 7	do	do	Grant, Colo.		66
September 4	do	do	do		26.5
December 15	do	do	do		13.5
July 5	Duck Lake Creek	Geneva Creek	Geneva Park, Colo.		3.7
December 29	do	do	do		a 2

a Estimated.

Miscellaneous measurements in Missouri River basin—Continued.

SOUTH PLATTE—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
June 7	Scott-Gomer Creek	Geneva Creek	Grant, Colo		[a] 16
December 29	do	do	do		[a] 4
June 7	Threemile Creek	do	do		[a] 3
December 29	do	do	do		[a] 1
1907.					
February 14	Plum Creek	South Platte River	Sedalia, Colo		[a] 3
March 10	do	do	do		[a] 10
March 28	do	do	do		[a] 1
March 20	do	do	Toluca, Colo		[a] 5
August 27	Bear Creek	do	Morrison, Colo		[b] 4,000
October 24	do	do	do		9.6
February 17	Cherry Creek	do	Denver, Colo		[a] 3
September 5	do	do	do		[b] 2,600
1908.					
June 17	Cherry Creek	South Platte River	Denver, Colo		47
1907.					
March 15	North Fork of Clear Creek.	Clear Creek	Forkscreek, Colo		[a] 4
March 16	do	do	do		4.7
April 11	do	do	do		16
April 23	do	do	do		23
May 10	do	do	do		46
August 9	do	do	do		[a] 25
October 11	do	do	do		7
December 5	do	do	do		6
1908.					
February 20	North Fork of Clear Creek.	Clear Creek	Forkscreek, Colo		4.7
March 16	do	do	do		[a] 5
May 21	do	do	do		17
June 17	do	do	do		20
August 15	do	do	do		6.3
October 30	do	do	do		5.4
December 11	do	do	do		2.8
1907.					
April 23	South Fork of Clear Creek.	Clear Creek	Forkscreek, Colo		92
1908.					
December 4	Clear Creek	South Platte	Golden, Colo	[c] 0.43	64
December 12	do	do	do	[c] 0.02	37
Do	do	do	do	[c] 0.02	36
December 28	do	do	do	[c] 1.42	65
1907.					
March 5	St. Vrain Creek	South Platte	Longmont, Colo		[a] 30
Do	Boulder Creek	St. Vrain Creek	Boulder, Colo		[a] 5
1908.					
September 3	South Fork of Middle Boulder Creek.	Boulder Creek	Above mouth of Jasper Creek.		6.8
Do	do	do	Below Jasper Creek reservoir site.		15.1
Do	North Fork of Middle Boulder.	do	Hessie, Colo		[d] 12.4
September 2	Selfridge and Mann power plant intake.	Middle Boulder	Sec. 35, T. 1 N., R. 72 W., Colo.		1.1
September 4	North Boulder Creek	Boulder Creek	Boulder Co. ranch		20.4
Do	Fourmile Creek	do	Sunshine, Colo		[a] 1.5
1907.					
March 13	Fourmile Creek	Boulder Creek	Boulder, Colo		[a] 3
March 19	do	do	do		[a] 5
April 12	do	do	do		8.3
April 22	do	do	do		13

[a] Estimated.
[b] Kutters formula estimate.
[c] Measurements taken at Denver Reservoir Irrigation Company's gage, and all but second one on December 12 were taken by the company's hydrographers.
[d] Float measurement.

Miscellaneous measurements in Missouri River basin—Continued.

SOUTH PLATTE—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
September 4	South Boulder Creek	Boulder Creek	Tolland, Colo	1.90	14.5
1907.					
March 5	South Boulder Creek	Boulder Creek	Marshall, Colo		[a] 12
March 13	do	do	do		[a] 7
March 18	do	do	do		[a] 15
April 12	do	do	do		[a] 20
1908.					
September 4	Perigo Ditch	South Boulder Creek	Rollinsville, Colo		[b] 2.8
September 3	Jenny Creek	do	Above head of Black Hills Ditch, Colo.		4.2
Do	Black Hills Ditch	Jenny Creek	Tolland, Colo		4.2
September 5	Left Hand Creek	St. Vrain Creek	Below mouth of California Gulch, near Ward, Colo.		[a] 4
Do	do	do	Goldhill, Colo		[a] 12
October 29	Crow Creek	South Platte River	Fort Russell, Wyo		[a] 15

KANSAS RIVER BASIN.

1908.					
September 17	Blue River	Kansas River	Millrace, Crete, Nebr		300
September 16	do	do	Wilber, Nebr		288
January 18	do	do	Beatrice, Nebr		292
February 29	do	do	do		705
March 27	do	do	do		347
April 25	do	do	do	2.15	305
May 19	do	do	do	2.25	383
June 5	do	do	do	15.10	12,200
June 23	do	do	do	7.20	3,700
July 25	do	do	do	3.61	990
September 16	do	do	do	2.42	307
October 23	do	do	do	2.52	470
November 28	do	do	do		378
December 30	do	do	do	2.38	370

[a] Estimated. [b] Float measurement.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 247

SURFACE WATER SUPPLY OF THE UNITED STATES

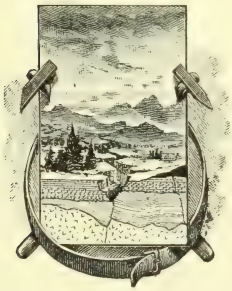
1907–8

PART VII. LOWER MISSISSIPPI BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

W. B. FREEMAN, W. A. LAMB
AND R. H. BOLSTER



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SURFACE WATER SUPPLY OF THE LOWER MISSISSIPPI RIVER BASIN, 1907–8.

By W. B. Freeman, W. A. Lamb, and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands it proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface-water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country.

These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp con-

ditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
			VIII	248	Western Gulf of Mexico.
III	243	Ohio River basin.	IX	249	Colorado River basin.
IV	244	St. Lawrence River basin.	X	250	Great Basin.
V	245	Upper Mississippi River and Hudson Bay basins.	XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	do	1903.
W. S. 124 to 135	do	1904.
W. S. 165 to 178	do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899 to 1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907–8.
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65, 75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65, 75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65, 75	83	98	127	168	204	242
St. Lawrence River	36	49	65, 75	(82), 83	97	129	170	206	244
Hudson Bay	.....	.....	66, 75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48, (49)	65, 75	83	98	128	169	205	243
Upper Mississippi River	36	49	65, 75	83	98, (99)	128, (130)	171	207	245
Missouri River	(36), 37	49, (50)	66, 75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66, 75	(83), 84	(98), 99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66, 75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37), 38	50	66, 75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66, 75	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100	134	177	213	251
North Pacific coast	38	51	66, 75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35.	James	
36.	Missouri	Gallatin.
37.	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38.	Sacramento	Except Kings and Kern.
39.	Great Basin	Mohave.
48.	Delaware	Wissahickon and Schuylkill.
49.	Ohio	Scioto.
50.	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65.	Lower Mississippi	Yazoo.
82.	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83.	Lower Mississippi	Yazoo.
97.	James	
98.	Lower Mississippi	Do.
99.	Upper Mississippi	Tributaries from the west.
128.	Lower Mississippi	Yazoo.
130.	Upper Mississippi	Tributaries from the west.
131.	Missouri	Platte, Kansas.
134.	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169.	Lower Mississippi	Yazoo.
177.	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205.	Lower Mississippi	Yazoo, Homochitto.
213.	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251.	Colorado	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miners' inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-feet.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river

recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 11, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $V = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are

subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200)[a] and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The editions of both of these water-supply papers are practically exhausted. They can, however, be consulted at most of the larger libraries of the country or they can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents for No. 180 and 35 cents for No. 200. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime

[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semipermanent or shifting sections with smooth, uniform current. So far as possible, stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

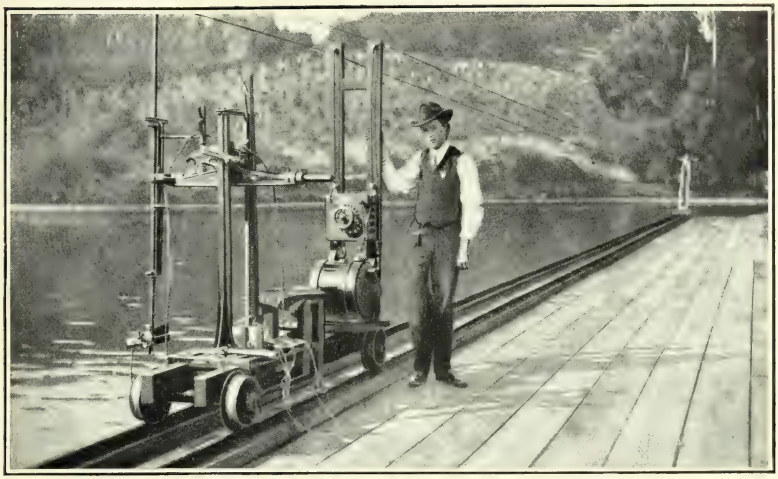
A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

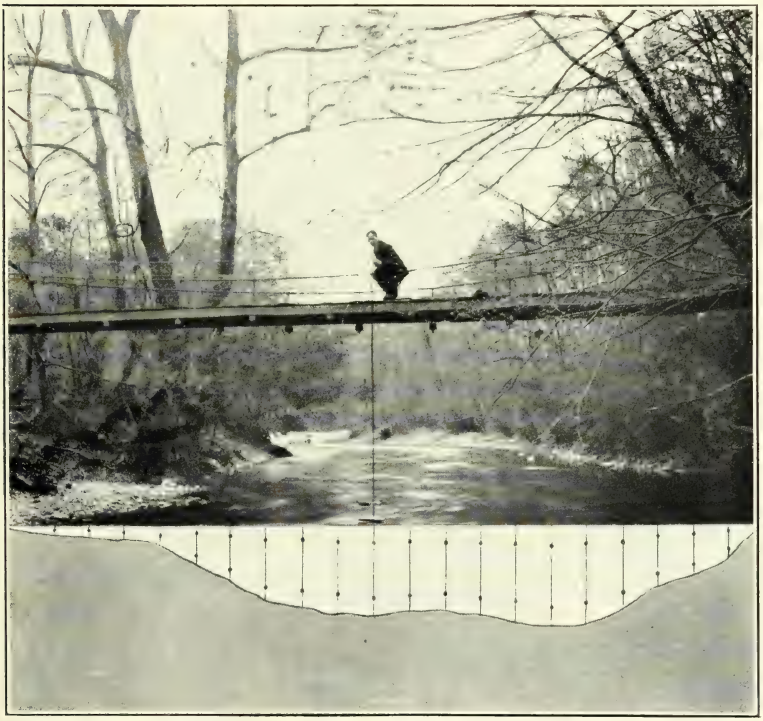
In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth at the time of measurement.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total discharge of the stream. (For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.



B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0.8 depth method.

or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method with its various modifications of surface, subsurface, and tube or rod floats is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per

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second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

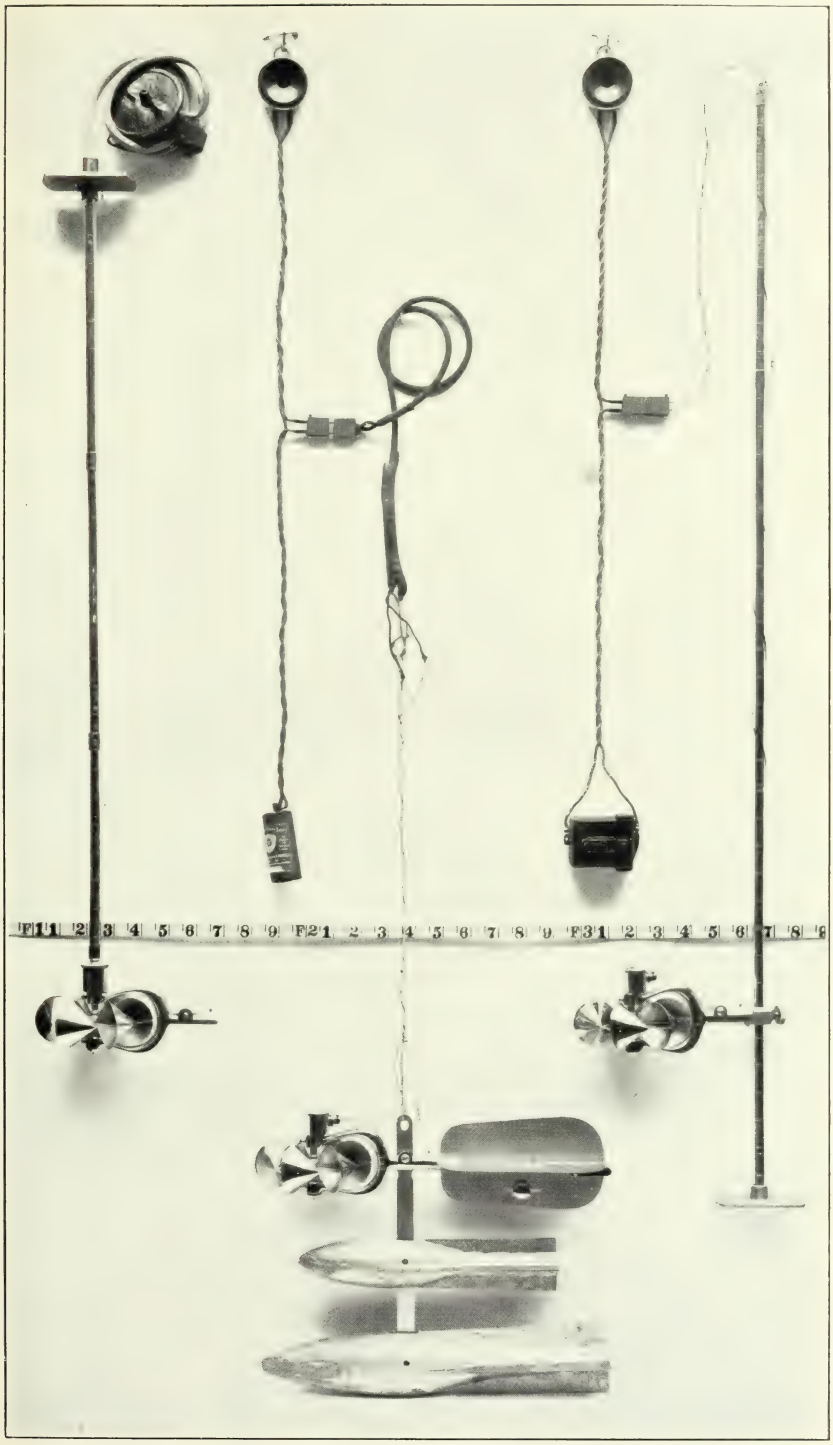
The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from



PRICE PENTA-RECORDING CURRENT METERS.

unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 15.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are as a rule comparatively permanent during low and medium stages and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class

give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. For illustrative examples of stations of this type see Water-Supply Paper 246.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct, but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either

reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect, and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another, and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. The following graphic method, devised by R. H. Bolster, for determining the daily discharge of streams of this class is now used by the engineers of the United States Geological Survey almost exclusively, owing to the rapidity with which the computations can be made, the clearness with

which changes in conditions of flow can be followed, and the accuracy of the results obtained.

The discharge measurements for the entire year are first plotted with discharges as abscissas and gage heights as ordinates. The points so plotted are considered chronologically and, even though scattered, will usually locate one or more fairly well-defined curves, called standard curves. (See fig. 1.) In general the number and position of these standard curves is determined by the radical changes in the stream bed due to floods.

When stream beds change very rapidly it is necessary to change the position of the rating curve daily, making a new curve for each day. This daily curve is of the same form as the standard curve and is parallel to it with respect to ordinates. The rating curve for a day when a measurement is made passes through such plotted measurement, the discharge for that day being read off from the scale of discharge in second-feet, at the point of intersection of the curve and the mean gage height for the day. In order to locate the rating curve for other days, lines are drawn connecting consecutive measurements. These lines are called correction curves and should have the same curvature as that portion of the standard curve which lies vertically above or below them. These lines are divided into as many equal parts as there are days intervening between the measurements, on the assumption that the change in conditions of flow between any two consecutive measurements is uniform from day to day. The daily rating curve will then pass through these points of division, and the discharge is read directly from these curves at their point of intersection with the observed daily gage heights.

To facilitate the use of the method and obviate the use of daily rating curves, and to make it as rapid in application as the common method for permanent stations, the standard curve or curves, together with a vertical line of reference, should be transferred from the original station sheet to tracing cloth, which can be readily shifted vertically to any desired position by always keeping the two vertical reference lines in coincidence. Thus the daily rating curve, which is merely the standard curve transferred, can be placed in any desired position.

Another way of simplifying the work of applying this method is to use dividers. Always keep one point of the dividers coincident with the standard curve and always keep both points on the same vertical line of discharge. By spreading the points, the point which is not coincident with the standard curve can be made to trace any daily rating curve desired.

In applying and modifying this method, judgment must be used for long-time intervals of no measurements or for radical changes in

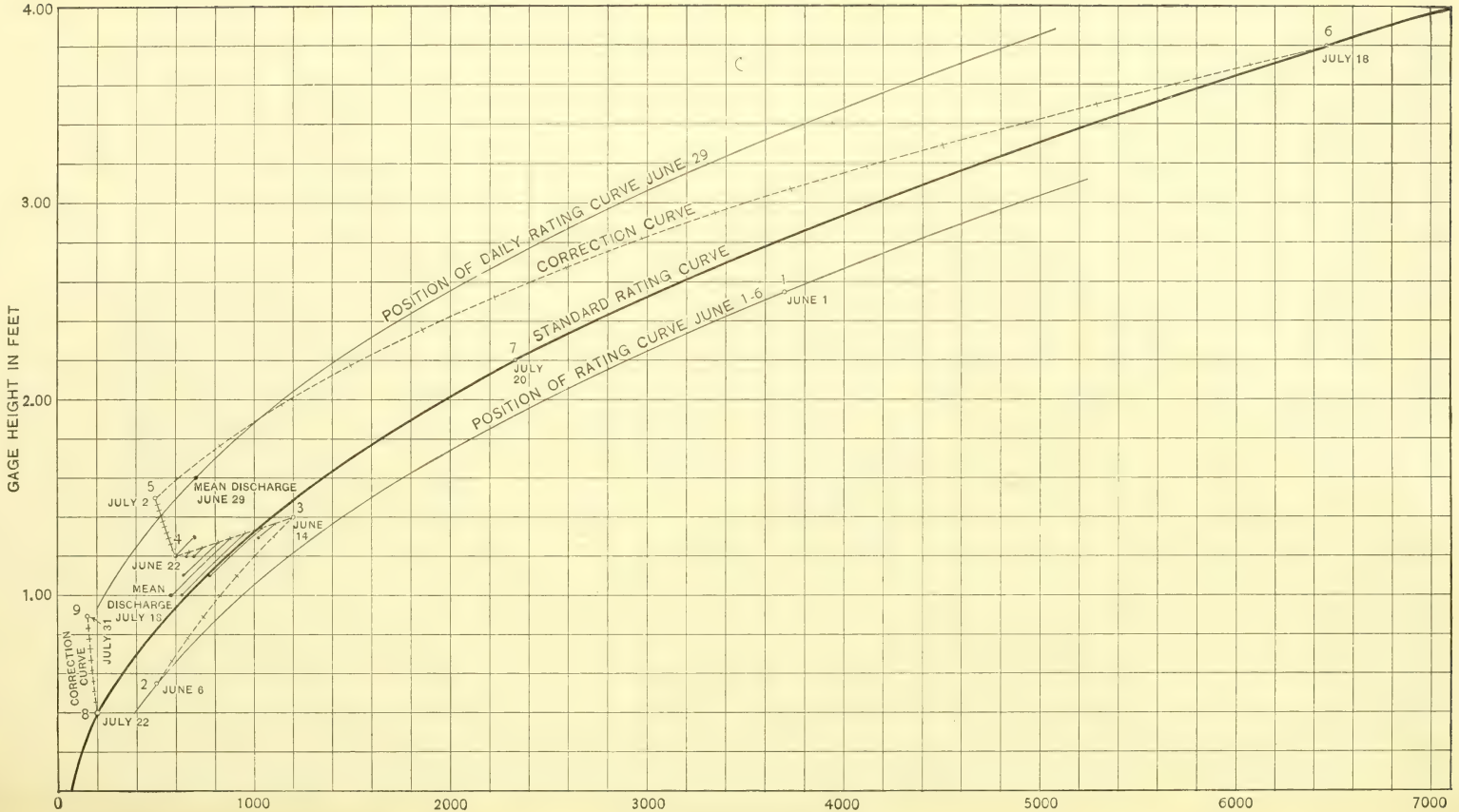


FIGURE 1.—Graphic method of determining daily discharge of streams with changeable beds.

the stream bed caused by sudden floods. The following tables and figure 1 illustrate the Bolster or graphic method of obtaining daily discharge:

List of measurements to illustrate graphic method of determining daily discharge.

No.	Date.	Gage height.	Discharge.	No.	Date.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
1	June 1	2.55	3,700	6	July 18	3.8	6,460
2	June 6	.55	500	7	July 20	2.2	2,330
3	June 14	1.4	1,200	8	July 22	.4	200
4	June 22	1.2	600	9	July 31	.9	150
5	July 2	1.5	500				

Daily gage heights and discharges to illustrate graphic method of determining daily discharge.

Day.	June.		July.		Day.	June.		July.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	3.0	4,870	1.5	530	16	1.1	760	3.5	5,370
2	2.5	3,580	1.5	500	17	1.0	620	3.2	4,610
3	2.0	2,490	1.5	570	18	1.0	580	3.7	6,150
4	1.5	1,610	1.6	730	19	1.1	640	4.0	7,080
5	1.0	930	1.6	780	20	1.2	690	3.0	4,160
6	.4	390	1.8	1,050	21	1.2	650	1.8	1,640
7	.6	510	1.7	970	22	1.3	690	.8	480
8	.6	490	1.7	1,020	23	1.5	850	.3	120
9	.7	550	1.9	1,320	24	1.8	1,170	.3	100
10	.8	620	2.0	1,510	25	1.7	990	.4	110
11	1.0	800	2.2	1,890	26	1.6	830	.4	90
12	1.5	1,400	2.6	2,720	27	1.6	780	.6	130
13	1.4	1,240	3.0	3,700	28	1.6	740	.7	150
14	1.4	1,200	3.6	5,440	29	1.6	700	.8	170
15	1.3	1,020	3.7	5,850	30	1.6	660	.9	180
					31			1.0	200

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States

Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates, they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly discharge table. In the rating tables "well defined" indicates in genera that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds of such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

Assistance has been rendered by the following persons:

The state engineer of Colorado, Mr. T. W. Jaycox, has paid the gage observers at most of the stations in the Arkansas River drainage in Colorado, and has very materially assisted the work in other ways.

The territorial engineer of New Mexico, Mr. Vernon L. Sullivan, has cooperated since July, 1907, in maintaining the gaging stations in the Canadian River basin in New Mexico, bearing at least half the expense of carrying on this work, and giving it his special interest.

The United States Reclamation Service has paid the expense of maintaining most of the stations in the Red River drainage in Oklahoma and that of some of the stations in the Canadian River drainage in New Mexico.

The American Beet Sugar Company paid the expense of maintaining the station on the Arkansas at Alfalfa, Colo.

The Wet Mountain Valley Irrigation Company paid practically all the expense of maintaining the gaging station on Grape Creek, near Canon City, during 1907 and 1908.

Thanks are also due to the United States Weather Bureau and the United States Forest Service for records furnished; to the Denver and Rio Grande, the Colorado and Southern, and the Atchison, Topeka and Santa Fe railways, for transportation in Colorado in 1907; to Prof. George J. Lyon for many discharge measurements taken along Arkansas River in 1907 and 1908; to Mr. C. A. Morse, chief engineer of the Santa Fe Railway for valuable flood data; to Mr. W. M. Wiley, president of the Amity Canal Company, for flood information and for the interest he has shown in this work; and to all other parties and companies who have furnished data.

Special acknowledgment is also due to the Tallahatchie Drainage Commission for bearing the expense of gage observers in the Yazoo River drainage basin.

DIVISION OF WORK.

The field data in the Arkansas River drainage in Colorado were collected under the direction of W. B. Freeman, district engineer, assisted by J. B. Stewart, C. L. Chatfield, and G. J. Lyon. This work was in charge of R. I. Meeker, district hydrographer until May 1, 1907.

The field data for the Canadian River drainage were collected under the direction of W. B. Freeman, district engineer, assisted by J. B. Stewart and R. L. Cooper. Since July 1, 1907, the New Mexico work has been under the more immediate direction of V. L. Sullivan, territorial engineer, assisted by C. D. Miller. W. A. Lamb, district hydrographer, was in charge of the work in this basin until July 1, 1907.

The field data for the Red River drainage were collected under the direction of W. B. Freeman, district engineer, assisted by R. L. Cooper. This work was under the direction of W. A. Lamb, district hydrographer, until July 1, 1907.

The field data for the Yazoo River drainage were collected under the direction of M. R. Hall, district engineer, assisted by Warren E. Hall and W. A. Lamb.

The ratings were made by W. B. Freeman, M. R. Hall, and R. H. Bolster. The computations and the preparation of the completed data for publication were made under the direction of R. H. Bolster, assistant engineer, assisted by G. C. Stevens, R. C. Rice, H. D. Padgett, J. G. Mathers, and M. I. Walters. The manuscript was edited by Mrs. B. D. Wood.

ARKANSAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The western rim of the Arkansas basin is formed by three of the highest mountain ranges of Colorado—the Saguache, Sangre de Cristo, and Culebra, each having summits more than 14,000 feet in altitude. The melting of the almost perpetual snow that mantles the high peaks near the north end of this rim furnishes water for three small creeks, the East, Lake, and Tennessee forks, which unite near Leadville to form the Arkansas.

From the junction of the forks the river flows a little east of south for about 75 miles, then turns to the east and cuts through a canyon whose perpendicular walls attain elevations of more than 2,000 feet above the water's edge, emerging finally into the plains region near Canon City. From Canon City to the Colorado-Kansas state line its general course is eastward for about 200 miles. Entering Kansas the river runs for 140 miles by general course a little south of east; it then makes a bold curve to the north, forming what is known as the Great Bend, below which it flows southeastward across Oklahoma to its junction with the Mississippi in northeastern Arkansas. The entire length of the stream from source to mouth is about 1,500 miles and its drainage basin includes about 177,500 square miles.

In its upper course the Arkansas is fed by numerous small streams, generally short, which lie wholly in or have their sources in the mountains. Those that head in the mountains and flow out onto the prairies are used more or less for irrigation. The most important of these tributaries are Greenhorn, Huerfano, Apishapa, and Purgatory rivers. The plains tributaries include Black Squirrel, Horse, Two Butte and Big Sandy creeks, Salt Fork, Cimarron, Verdigris, Grand, and Canadian rivers, and scores of smaller streams. The largest of these tributaries is Canadian River.

Above Pueblo, Colo., the drainage basin is generally mountainous, but toward the south the elevation decreases and the country is well marked by stream channels that trend in a general northeasterly

direction. The streams on the north flow generally southward when they emerge from the mountains.

At the base of the mountains are the foothills, irregular and seared by canyons, and marked by disconnected mesas and buttes of different but moderate altitudes; beyond are great level plains, extending far to the east and constituting a portion of what was formerly known as the Great American Desert. East of the foothills and north of the river the topography is that typical of the Great Plains region, but to the south the surface of the plains is generally more accented. That part of the drainage basin that extends from the mountains to the Colorado-Kansas line embraces an area of about 25,000 square miles. Beyond this is the flat semiarid section of western Kansas, and then the more humid country in eastern Kansas, Oklahoma, and Arkansas.

The rocks exposed in the mountainous area present great variety, ranging from metamorphic granites of Pikes Peak and the Royal Gorge of the Arkansas, to the glacial drift in the upper valley of the Arkansas from Salida to Leadville, and the upper Grape Creek Range. Next to the granites the eruptives are most common, and sedimentary rocks are found over wide areas.

In the plains region the principal rock exposures seen along the heavily eroded stream channels are shales, sandstone, and lime rock in alternating layers. The soil cover, which is necessarily rather meager in the mountainous section, varies in the plains region from the upland sands and gravels of the mesas to the sandy loams and adobe clays of the river valleys. The adobe soils are very friable and dry, and melt away rapidly under the action of water. Many of the dry intermittent channels, usually termed arroyos, are narrow and have high perpendicular walls, and are cut deeper by each succeeding flood. The vegetation is scanty, consisting of native grasses, sage brush, chico, and cactus pads. The ranges have been very closely pastured, making conditions conducive to an excessive flood run-off.

Above Canon City the fall of the river is about 40 feet to the mile. The elevation at Canon City is 5,300 feet; at the Colorado-Kansas state line, 220 miles below, the elevation is 3,350 feet, making the average fall about 9 feet per mile. At the mouth the river has an elevation slightly exceeding 100 feet above sea level.

The drainage basin of Arkansas River contains about 1,000 square miles of merchantable timber land and considerably more than that amount of woodland; the rest, except for the considerable area under cultivation, may be classed as barren and sage brush land.

The principal source of the water which the river bears to the plains is the precipitation along the crest of the high ranges. This is mainly in the form of snow, and amounts to 20 or 30 inches each

year. From the foothills to Arkansas City the precipitation ranges from 12 to 35 inches, being 25 to 35 inches in the last 100 miles below Hutchinson. The natural storage in the basin is limited to a few mountain lakes of glacial origin.

The streams of this drainage area are subject to floods of two kinds—the annual spring floods caused by the melting of the snows in the headwater regions and floods caused by the violent storms, locally known as cloudbursts, in the foothills and plains regions. Occasionally, too, the river runs dry, and many of the tributaries are intermittent in character.

As altitudes within this basin range from 14,000 feet almost down to sea level, the climatic conditions vary greatly. In the mountainous sections the winters are severe, the snowfall is heavy, and the rivers have a thick ice cover for several months. As the altitude decreases the winters become milder.

At the present time about one-half million acres of land are under irrigation on Arkansas River and its tributaries in Colorado, but beyond the Colorado line only a very few thousand acres are irrigated. The Garden City project of the United States Reclamation Service will eventually provide for the irrigation of probably 15,000 acres in the Arkansas Valley in western Kansas, principally by pumping the underflow.

Numerous reservoirs now in operation along the Arkansas, together with direct diversions for irrigation, provide for the use of the greater part of the flow of the Arkansas River in Colorado. The largest reservoirs are in the system of the Great Plains Reservoir Company, on the north side of the river in the eastern part of the State. The reservoirs of this system are supplied by feeder canals, and have a combined capacity of almost 200,000 acre-feet. Other reservoirs now contemplated or under construction, on the tributaries of the Arkansas, will provide for the irrigation of a large additional area. These reservoirs are necessitated by the intermittent character of the streams upon which they are situated. The basin contains many excellent reservoir sites. The flood on the Arkansas in October, 1908, illustrates the possibility for additional storage in some of them. (For report on this flood, see page 33.)

On account of the use of water for irrigation in the open country, power development is necessarily confined to the upper reaches of the Arkansas and its tributaries. It seems probable that, with proper storage, about 100,000 horsepower can be developed. Somewhat over 5,000 horsepower is now being used.

The years of greatest average flow on the upper Arkansas since the beginning of measurements seem to have been 1891 and 1899. The flow in 1905 was also very high and that in 1906 and 1907 was nearly as great. The year of lowest flow is 1902, while 1908 is second.

Following is a list of gaging stations maintained in this basin, together with length of record:

Arkansas River near Granite, Colo., 1895, 1897–1899, 1901.
Arkansas River near Salida, Colo., 1895–1903.
Arkansas River at Canon City, Colo., 1888–1908.
Arkansas River near Rock Canyon, Colo., 1889.
Arkansas River above Pueblo, Colo., 1885–9.
Arkansas River at Pueblo, Colo., 1894–1908.
Arkansas River near Nepesta, Colo., 1897–1903.
Arkansas River near Manzanola, Colo., 1898.
Arkansas River near Rocky Ford, Colo., 1897–1903.
Arkansas River at La Junta, Colo., 1889, 1894, 1895, 1901, 1903, 1908.
Arkansas River near Las Animas, Colo., 1898.
Arkansas River near Prowers, Colo., 1900, 1901, 1903.
Arkansas River near Amity canal head gates, Colo., 1898, 1899.
Arkansas River near Granada, Colo., 1898–1901, 1903.
Arkansas River near Barton (Byron), Colo., 1901, 1902.
Arkansas River at Holly, Colo., 1907–8.
Arkansas River near Syracuse, Kans., 1903–6.
Arkansas River near Coolidge, Kans., 1903.
Arkansas River near Dodge, Kans., 1902–6.
Arkansas River near Hutchinson, Kans., 1895–1905.
Arkansas River near Arkansas City, Kans., 1902–6.
Arkansas River, East Fork, near Leadville, Colo., 1890, 1903.
Arkansas River, Tennessee Fork, near Leadville, Colo., 1890, 1903.
Arkansas River, Lake Fork, near Arkansas Junction, Colo., 1903.
Arkansas River, Lake Fork, near Leadville, Colo., 1890.
Lake Creek near Twin Lakes, Colo., 1899–1900.
Clear Creek near Granite, Colo., 1890.
Cottonwood Creek, Middle Fork, near Buena Vista, Colo., 1890.
Cottonwood Creek, South Fork, near Buena Vista, Colo., 1890.
Grape Creek near Canon City, Colo., 1907–8.
Huerfano River near Undercliffe, Colo., 1908.
Oxford Farmer's Canal near Nepesta, Colo., 1902–3.
Cucharas River at Walsenburg, Colo., 1907–8.
Purgatory River at Trinidad, Colo., 1896–9, 1905–8.
Purgatory River near Canyon Entrance (Alfalfa), Colo., 1905–7.
Purgatory River near J. J. Ranch, Colo., 1898.
Purgatory River near Las Animas, Colo., 1889.
Colorado-Kansas canal near Prowers, Colo., 1903.
Keese ditch near Prowers, Colo., 1903.
Walnut River near Arkansas City, Kans., 1902–3.
Arkansas River (Salt Fork) near Alva, Okla., 1902–5.
Arkansas River (Salt Fork) near Tonkawa, Okla., 1903–5.
Medicine River near Kiowa, Kans., 1895–6.
Verdigris River near Independence, Kans., 1904.
Verdigris River near Liberty, Kans., 1895–1903.
Verdigris River near Catoosa, Okla., 1903–5.
Fall River near Fall River, Kans., 1904–5.
Neosho River near Neosho Rapids, Kans., 1904.
Neosho River near Iola, Kans., 1895–1903.
Neosho River near Humboldt, Kans., 1904.
Neosho River or Grand River near Fort Gibson, Okla., 1899, 1903–5.

FLOOD[a] IN THE ARKANSAS VALLEY, COLORADO, OCTOBER, 1908.

CAUSE OF FLOOD.

The flood here described was caused by very heavy rains on the night of Sunday, October 18, 1908. The territory most affected by these rains in the Arkansas drainage area, comprising something like 5,000 square miles, reached to Lamar on the east, to the Missouri-Pacific tracks on the north, to a line extending from La Junta to the Cedars on Purgatory River on the west, and to a line running from the Cedars on the south. (See fig. 2.)

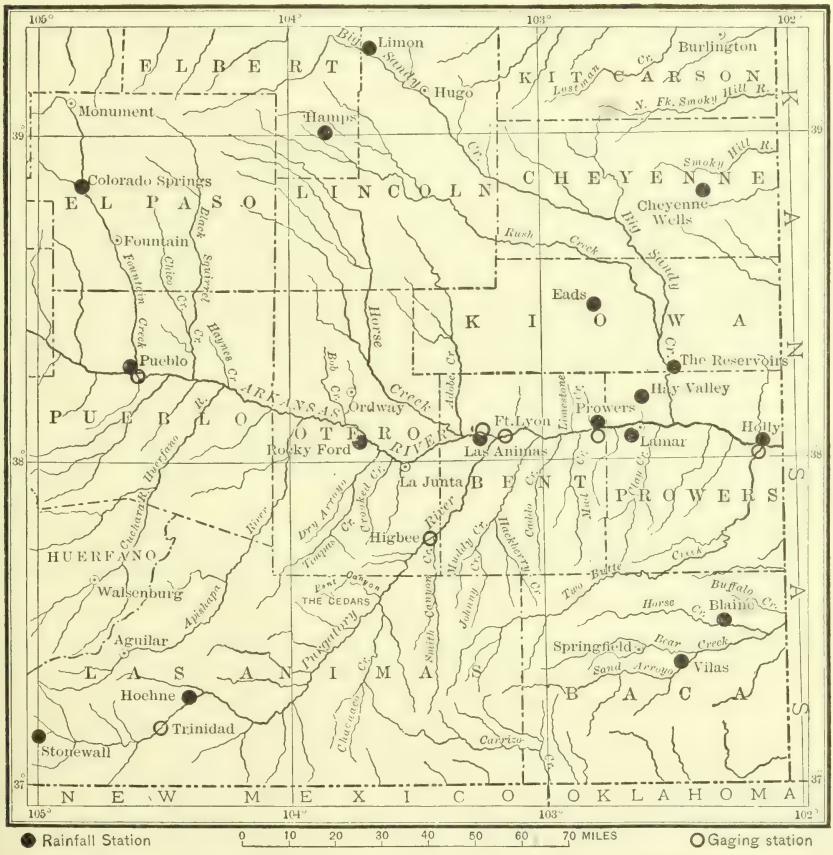


FIGURE 2.—Map of Arkansas Valley, Colorado, showing rainfall and gaging stations.

Conditions in the lower Arkansas Valley are described by Mr. W. M. Wiley, president of the Amity Land Company and a resident of Holly:

A drizzling rain fell at Holly all day Sunday, with wind from the east. During the night the wind changed suddenly and began to

[a] Report by W. B. Freeman, district engineer.

blow from the south, an unusual direction in that section during a storm. Flashes and streaks of lightning illuminating the sky indicated a great storm somewhere in the locality, though it was not raining heavily at Holly. The next morning Arkansas River at Holly was in flood, though it had shown no signs of a rise 6 o'clock the night before.

Rain gages at various points on the canals of the Amity system, which extends for many miles along the north side of the river in eastern Colorado, recorded precipitations unprecedented in that section. Practically all of this rainfall is believed to have taken place during about eight hours on Sunday night. At the Reservoirs (Great Plains), 40 miles northwest of Holly, the record was 6¼ inches; at Smith head gate, near Prowers, 6 inches; at May Valley, a few miles north of Lamar, it was 6.34 inches.

The records of the United States Weather Bureau show that on October 19 there was 3.87 inches of rainfall at Lamar and 1.42 at Las Animas. At Eads, about 10 miles north of the Reservoirs, on the same day it was 5.95 inches, and at Limon, at the extreme northern end of the drainage basin, it was 1.41 inches. No other figures of excessive rainfall are obtainable, though it appears that farther east and north the heaviest rainfall occurred on October 18. For instance, at Rocky Ford on that date 1.76 inches fell; at Colorado Springs, 1.24 inches; at Pueblo, 0.46 inch. The rainfall at Holly on Sunday night was about 0.70 inch, which was practically all that fell there during October. On Big Sandy Creek, about 10 miles above its mouth, the precipitation recorded at the company's gage on Sunday night was 4.25 inches.

The following table, compiled from records of the Weather Bureau from October 17 to 21, 1908, shows the amount of precipitation in the Arkansas drainage basin:

Precipitation in the Arkansas drainage basin, October 17 to 21, 1908, as shown by records of the Weather Bureau.

Place.	Oct. 17.	Oct. 18.	Oct. 19.	Oct. 20.	Oct. 21.
Blaine	0	(a)	1.40	0	0
Cheyenne Wells	0	0.22	4.53	0	0
Colorado Springs	T.	1.24	.07	0	0
Eads	0	0	5.95	0	0
Hamps	0	.90	1.36	0	0
Hoehne	0	.22	.60	0	0
Holly	T.	.70	T.	0	0
Lamar	0	0	3.87	0	0
Las Animas	0	.64	1.42	0	0
Limon	0	.62	1.41	0	0
Pueblo	T.	.46	T.	0	0
Rocky Ford	0	1.76	0	0	0
Stonewall	0	.57	T.	.04	0
Vilas	0	.37	1.33	0	0

[a] Precipitation included in record for following day.

The flood appears to have had two distinct parts. The first, which was caused by the run-off from the excessive rain on the north side of the drainage area in the vicinity of the reservoirs, was accentuated on Monday evening, October 19, by the flood waters from the lower tributaries of the Arkansas on the south side. The second flood was caused by the flood waters from Purgatory River, Rule Creek, Caddoa Creek, Mud Creek, and other streams on the south side, the waters of which had to travel a considerable distance.

FIRST FLOOD.

The first flood reached a maximum at Holly, Colo., some time before midnight on Monday, October 19. On Monday afternoon the United States Geological Survey gage at that point recorded a gage height of 9.80 feet.

Throughout the territory affected the ground was very hard and dry; moreover, it had been ranged so closely that practically no vegetation was left. All of these conditions, combined with a rainfall of such unusual intensity, were conducive to an extremely large percentage of run-off. It is believed that of the 6 inches of rainfall at places on the north side, as much as two-thirds, or even more, appeared immediately in the streams. It is stated that on the north side the water flowed away in a perfect sheet, overspreading the whole country and running into the river chiefly below the Amity dam at Prowers, causing a very rapid rise.

Probably most of this flood water would have flowed away by midnight on Monday, but Two Butte Creek, which enters on the south just above Holly, reached its maximum late on Monday evening, and the waters of this stream and the smaller tributaries of the Arkansas above combined with the waters from the north side to produce a maximum flow at Holly about midnight on Monday. From that time until Tuesday the river fell slowly, the gage at Holly being about 0.50 foot below the maximum at 8.30 on Tuesday morning.

Big Sandy Creek appears to have been on the extreme eastern edge of the flood belt. It is estimated that the maximum flow of this creek did not exceed 5,000 or 6,000 second-feet. Wild Horse Creek, which comes into the river from the north side just at Holly, showed very little rise, the water being 3.90 feet below the base of the rail at the Atchison, Topeka and Santa Fe Railway bridge across the creek.

The tracks of the Arkansas Valley Railway, on the north side of the river, were badly washed out in a few places, particularly at Bristol and Wiley, northwest of Lamar. The Amity, Kicking Bird, Satanta, Comanche, and Buffalo canals of the Amity Land Company also suffered many breaks, which cost several thousand dollars to repair.

A heavy run-off is reported from Limestone and Graveyard creeks west of Wiley, and it is probable that the heavy rainfall was felt a considerable distance west of these streams. The waters of both were at very high stage, broke all the ditches crossing them, and carried away the highway bridges along their courses.

SECOND FLOOD.

The second rise in the river was due to the flood waters of the Purgatory and other streams below on the south side. A maximum gage height of 11 feet was attained at Holly about noon on Tuesday, October 20. The records show no appreciable rise in the Purgatory at Trinidad, and the southern limit of the heavy rainfall is believed to have been somewhere in the neighborhood of the Cedars and about 40 miles below Trinidad. The rainfall at Hoehne was only 0.60 inch on October 19, as shown by the records of the United States Weather Bureau. An enormous run-off was reported from Smith Canyon, Bent Creek, and other tributaries of the Purgatory. The river was out of its banks at the Atchison, Topeka and Santa Fe Railway bridge near Las Animas, and it overflowed the country for a considerable distance on each side of the river channel. The Purgatory did not, however, reach a stage as high as during several other floods in the past. At the Atchison, Topeka and Santa Fe Railway bridge the high water was 6 feet below the base of the rails, and for about the first time in the flood history this bridge was not damaged. One reason that the river did not get higher was that there was little back-water effect from Arkansas River.

Rule Creek, the first important tributary of the Arkansas below the Purgatory on the south side, rose to an almost unprecedented stage. At the Atchison, Topeka and Santa Fe Railway bridge the water was 3 feet below the base of the rails, though in the flood of September, 1894, the records of the railway company show that the water was a foot or more higher. It is stated, however, by Mr. J. D. Rhoads, who has a ranch 10 miles above the mouth of the creek and who has resided there for over thirty-five years, that the creek at his ranch in the 1908 flood was several feet higher than ever before. His sheep corrals, which had never been inundated, were submerged to a depth of several feet. During the present flood the creek channel was not capable of carrying all the flood water, and the overflow, beginning at a point one-half mile or so east of the bridge, covered the railroad tracks to a depth of 6 inches to 2 feet for a distance of nearly 2 miles. At various places along this stretch the embankments were badly washed out and the tracks forced out of alignment. West of the bridge the overflow covered the tracks to a depth of 16 to 18 inches for a considerable distance. A great many sheep were drowned by the flood waters along this stream.

At Caddoa and vicinity the tracks were overflowed by the water from Arkansas River proper and were washed out in spots. At Caddoa siding the high water was 6 inches over the top of the rails. Caddoa Creek was at a high stage, but did little damage to the Santa Fe tracks. Mud Creek is said to have been higher than at any time within the last thirty-five years, and the overflow did a great deal of damage to the bottom lands and haystacks. Near Martin the water was over the track in many places. In the vicinity of Prowers, Mud Creek did considerable damage to the track. The overflow waters, combined with the flood waters from a break in the Colorado-Kansas canal, covered a stretch of track over 1,000 feet long, a little east of Prowers, to a depth of over 2 feet in many places, and in others washed away the roadbed very badly.

At the railroad bridge over Dry Creek the high water was 10 feet below the base of the rails, though in the flood of August 2, 1905, it was up to the stringer of the bridge. At Clay Creek crossing, west of Morse, in the present flood, the high-water mark was 5.5 feet below the base of the rails.

The tributaries on the south side below Morse were all at high stages, but most of the damage below that point was done by the river itself. In the house of the Phillips Investment Company at Prowers, which is some distance south of the Amity dam, the water reached a depth of 5 feet. It is said that the water in the river at this point was a foot higher than at any time within the memory of the oldest inhabitant. The Colorado-Kansas dam and the head-gate of the canal on the south side just below Martin were washed out, nothing being left of the dam but a part of the south end. No appreciable damage was done to the Amity dam. Twenty-four Circle ranch, extending along the south river bottom for several miles above and below Prowers, was badly flooded, and haystacks were carried away (1,200 tons). Fortunately the land was not very badly cut to pieces; about 1,400 acres are under cultivation.

The highway bridge at Morse was practically destroyed, while 27 bents were washed out of the old railway bridge on the branch from Lamar to the Arkansas Valley Railway.

At Amity depot the high water from the river was 1.4 feet above the top of the rail, and for nearly 1,000 feet east the track was under water and badly washed out in places. At two long stretches east of Amity the high water line was over the roadbed, being from the level of the bottom of the rail to 16 inches above the top of the rail. At the bridge across Arkansas River, about a mile west of Amity, the high-water line was 14 feet below the base of the rail.

DAMAGES CAUSED.

From October 19 to 21, therefore, Arkansas River from the mouth of the Purgatory to the Mississippi was in continuous flood. In Colorado all the bottom lands were flooded; the railway embankments were overflowed and cut into pieces in many places, and traffic was delayed for about six days. The right-of-way fences and the fences of many fields were covered with drift, and sediment and rubbish were deposited on the meadows and cultivated lands; fields were badly torn up by the flood waters and the canal systems were cut to pieces. On both sides of the river the flood waters rushed over canals as though they were not there at all. All the highway bridges on the river, from the mouth of the Purgatory to the Kansas line, were washed away, except those at Granada and Holly. Many farmhouses were flooded and two or three towns were inundated. At places in the town of Amity the water was 4 feet deep. A few people in the Arkansas Valley were drowned by the flood waters and a great many thousand sheep.

The Santa Fe Railway Company had an extra force of some 800 men engaged for about a week in repairing the damage done to their tracks. The direct loss to the railway company was probably $50,000, and the loss due to delay in traffic is hard to estimate. The repair crews were not able to get in until Wednesday, October 21, and the first trains did not get through until late on Friday night, October 23.

Complete statistics on the damage done by this flood in Colorado have not been obtained; but it is believed that, exclusive of traffic loss to the Atchison, Topeka and Santa Fe Railway, it is about a quarter of a million dollars, distributed as follows:

Damage caused by flood of October, 1908, in Arkansas Valley, in Colorado.

Atchison, Topeka and Santa Fe Railway:		
Damage to track, main line, La Junta to Morse	$30,000	
Lamar branch	7,000	
Rocky Ford branch	3,000	
		$40,000
Phillips Investment Company (near Prowers, Colo.):		
Damage to land, hay and grain in stacks, ditches, buildings, fences, etc	18,000	
Damage to Colorado-Kansas dam, head-gates, and ditches	13,000	
		31,000
Amity Land Company, damage to canals on north side		8,000
J. D. Rhoads, sheep drowned on Rule Creek		10,000
P. G. Scott, damage to land and hay from Rule Creek and Purgatory River		2,000
James Malloy, damage to land, hay, fences, etc., from Rule Creek		3,000
Bent County, damage to roads and bridges		25,000
Prowers County, damage to roads and bridges		35,000
All other damages, including that to land, haystacks, buildings, and loss of sheep and other stock, but not including the loss due to delay in railroad traffic, estimated		100,000
Total		254,000

GAGE HEIGHTS.

The accompanying table shows the recorded gage heights on the Arkansas and Purgatory during this flood.

Gage heights, in feet, at various points on streams in Arkansas River drainage basin, October 18 to 23, 1908.

Date.	Arkansas at—								Purgatory at Trinidad.	
	Pueblo.		La Junta.		Prowers.[a]		Holly.			
	Time.	Gage height.	Time.	Gage height.	Time.	Gage height.	Time.	Gage height.	Time.	Gage height.
Oct. 18	8.00 a. m.	2.10	7.40 a. m.	0.30	.....	0	7.00 a. m.	0.60	8.00 a. m.	4.20
	5.00 p. m.	2.15	5.10 p. m.	1.50	.....	.....	5.00 p. m.	.60	8.00 p. m.	4.70
Oct. 19	8.00 a. m.	2.20	7.05 a. m.	6.20	10.00 a. m.	6.00	7.00 a. m.	5.80	7.00 a. m.	4.40
	5.00 p. m.	2.25	12.00 m.	5.50	8.00 p. m.	5.00	5.00 p. m.	8.40	4.30 p. m.	4.30
			5.15 p. m.	3.50						
Oct. 20	8.00 a. m.	2.30	7.05 a. m.	2.50	1.00 a. m.	7.00	7.00 a. m.	9.60	8.00 a. m.	4.25
	5.00 p. m.	2.20	5.25 p. m.	1.70	9.00 a. m.	2.50	12.00 m.	11.00	4.00 p. m.	4.30
					6.00 p. m.	1.00				
Oct. 21	8.00 a. m.	2.20	7.25 a. m.	1.70	8.00 a. m.	.60	7.00 a. m.	4.60	8.00 a. m.	4.30
	5.00 p. m.	2.20	5.10 p. m.	1.70	6.00 p. m.	.40	5.00 p. m.	4.00	4.00 p. m.	4.30
Oct. 22	8.00 a. m.	2.20	7.05 a. m.	1.70	8.00 a. m.	.30	7.00 a. m.	3.00	8.00 a. m.	4.35
	5.00 p. m.	2.45	5.15 p. m.	1.70	.....	.....	5.00 p. m.	3.00	5.00 p. m.	4.35
Oct. 23	8.00 a. m.	2.50	7.40 a. m.	1.50	.....	.....	7.00 a. m.	3.00	7.00 a. m.	4.35
	5.00 p. m.	2.50	5.25 p. m.	1.50	.....	.....	5.00 p. m.	3.00	6.00 p. m.	4.30

[a] United States Weather Bureau.

Other gage heights observed at the United States Weather Bureau gages were as follows:

Arkansas at Las Animas, 3.60 on October 19.

Arkansas at Fort Lyon, 10.50 on October 20; maximum gage height at 9 p. m. on October 19.

Purgatory (Las Animas) at Higbee, 14 on October 19; 4 on October 20.

This river was practically dry before the flood, and the estimated discharge at the mouth was only 100 second-feet on October 24.

The Arkansas reached a maximum stage at the Amity dam about 1 a. m. on Tuesday, October 20. At that time there were about 7 feet of water running over the weir and a stream about three-fourths of a mile wide was running around the south end of the dam. This is believed to be the maximum flood height ever reached at this point. The discharge was estimated to be over 100,000 second-feet.

At Holly there was a rapid rise in the river from 8.30 a. m. on Tuesday, October 20, until about 12.30 p. m., when the maximum flood height of about 11 feet was obtained. At that time the river was spread from the railway tracks at Holly on the north to a point about one-quarter of a mile beyond the river channel on the south. The pile bridge, however, is quite high and was not damaged in any way. From 12.30 to 4 p. m. on Tuesday there was a fall of about 0.6 foot in the river height, and a very rapid fall from that time on.

At Garden City, Kans., 80 miles downstream from Holly, the maximum stage was reached at 10.30 p. m. on Tuesday. The flood

crest, therefore, traveled a distance of about 80 miles in 10 hours, or at a rate of nearly 12 feet per second. On the other hand, it seems that it took the flood crest nearly twelve hours to go from Amity dam to Holly, a distance of less than 50 miles. No explanation is offered for this discrepancy. The flood crest traveled from Fort Lyon to the Amity dam, a distance of about 20 miles, in four hours. A flood cross section was taken at Holly by the engineers of the Amity Land Company. This cross section had an area of 13,600 square feet at the maximum gage height of 11 feet, and the estimated discharge is 136,000 second-feet.

Two Butte Creek had a maximum flood cross section of 3,500 square feet, and the estimated maximum discharge is 35,000 second-feet. This is at the rate of nearly 39 second-feet per square mile for a drainage area of 900 square miles.

The flow of a great many other streams in the vicinity was in proportion to the above.

RÉSUMÉ.

Many floods have occurred in the Arkansas Valley in the past, and the flood of October, 1908, had few unusual features. In the flood of 1908, however, the intensity of the rainfall was probably greater than in most ordinary floods, and the conditions were more favorable for a rapid run-off, and the area affected was unusually large. Fortunately upper Arkansas River was not in flood or the results would have been exceedingly disastrous.

Had this flood occurred a month earlier, before the crops had been harvested, the damage would have been much greater; as it was, the loss was not less than $250,000. The railroad company suffered a large proportion of the damage, because the railroad tracks cross so many of the tributary water courses. The loss of a bridge or a section of track from a cloudburst along one or two of these torrential streams is by no means uncommon.

Floods of this character can be prevented only by constructing storage reservoirs on the tributaries. Until this is done life and property will never be safe in that section.

ARKANSAS RIVER PROPER.

ARKANSAS RIVER AT CANON CITY, COLO.

This station, which was established April 17, 1889, is located at the mouth of the canyon, just below the suspension footbridge at Hot Springs Hotel, about 1½ miles above the Denver and Rio Grande Railroad depot at Canon City, Colo. Measurements are made from a cable.

The records at this point show the greater part of the run-off of the river and are valuable both for power and irrigation projects.

Grape Creek enters about one-eighth of a mile above the station and Oil Creek comes in about 5 miles below. The drainage area

comprises about 3,000 square miles. North and South Canyon ditches divert water above the station, and their flow is not included in the run-off. No accurate records have been kept of the discharge in these canals, but the combined flow is from 50 to 100 second-feet during the irrigation season. Some water is also diverted for the irrigation of a few thousand acres on the upper Arkansas and its tributaries.

The flow of the river is affected by ice for three or four months during the winter season.

On October 4, 1895, a new rod gage was established on the left bank, opposite the original gage and at the same datum. This gage read 0.4 foot lower than the old gage at low stages, but at high water both gages read the same. This new gage was used until August 26, 1902, when another gage was established a few yards above the cable on the right bank at the datum of the original gage, though it is situated a short distance farther downstream.

As the stream bed is rough it is difficult to obtain very accurate measurements at high stages. Moreover, the channel is subject to considerable shifting, which makes the estimates of daily discharge rather uncertain, especially after violent flood.

Discharge measurements of Arkansas River at Canon City, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 24	W. B. Freeman	93	355	5.02	1,740
1908.					
October 15	C. W. Beach	.....	114	2.90	201
November 21[a]	G. J. Lyon	56	108	3.20	314

[a] Measured from suspension bridge.

Daily gage height, in feet, of Arkansas River at Canon City, Colo., for 1907 and 1908.

[Samuel Isabell and S. R. McKissick, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1907.[a]						1907.					
1	3.6	4.7	6.95	5.4	4.45	16	3.9	6.05	5.8	4.65	3.75
2	3.6	4.4	6.8	5.35	4.2	17	3.8	6.0	5.65	4.4	3.75
3	3.6	4.7	6.65	5.4	4.2	18	3.8	6.1	5.5	4.1	3.8
4	3.6	5.05	6.65	5.3	4.0	19	3.9	6.3	5.5	4.1	3.85
5	3.6	5.25	6.8	5.05	4.1	20	4.1	6.05	5.4	4.3	3.85
6	3.6	5.45	6.75	4.85	4.1	21	4.55	5.85	5.45	4.35	3.85
7	3.6	5.45	6.55	4.7	4.1	22	5.15	5.75	5.4	4.3	4.05
8	3.6	5.4	6.5	4.7	4.1	23	5.45	5.7	5.3	4.4	4.1
9	3.6	5.3	6.45	4.55	3.9	24	5.45	5.9	5.1	4.35	4.1
10	3.5	5.2	6.3	4.45	3.85	25	5.3	6.0	5.2	4.35	4.05
11	3.5	5.05	6.2	4.4	3.85	26	5.15	6.25	5.6	4.45	4.1
12	3.5	5.15	5.95	4.2	3.85	27	4.95	6.25	[b] 5.95	4.45	3.75
13	3.65	5.35	5.95	4.7	3.75	28	4.9	6.4	6.1	4.45	3.75
14	3.7	5.7	6.25	4.7	3.75	29	4.8	6.6	5.75	4.35	3.75
15	3.8	6.05	6.2	4.75	3.75	30	4.85	6.6	5.6	4.65	3.75
						31	4.85	.....	5.5	4.8	.....

[a] Old gage washed out July 27, 1907. Gage heights July 28–Sept. 30, 1907, read from temporary gage, have been reduced to datum of old gage.

[b] Maximum gage height, July 27, 1907, was over 8.0 feet.

Daily gage height, in feet, of Arkansas River at Canon City, Colo., for 1907 and 1908—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.[a]								1908.							
1	.....	4.35	4.6	4.1	3.3	2.9	3.1	16	.....	5.15	4.4	3.5	2.9	2.9	3.25
2	.....	4.4	4.55	4.2	3.25	2.8	3.0	17	.....	5.1	4.5	3.4	2.9	2.9	3.3
3	.....	4.3	4.4	4.25	3.25	2.8	3.05	18	.....	5.35	4.3	3.5	2.9	3.15	3.25
4	.....	4.35	4.45	4.0	3.2	2.8	3.05	19	.....	5.25	4.3	3.95	2.85	3.3	3.3
5	.....	4.6	4.4	4.85	3.15	2.8	3.1	20	.....	4.85	4.05	3.8	2.8	3.2	3.2
6	.....	4.55	4.4	3.8	3.1	2.85	3.1	21	4.3	4.7	4.0	3.85	2.75	3.2	3.25
7	.....	4.55	4.4	3.9	3.1	2.8	3.1	22	4.25	4.85	3.95	4.2	2.8	3.55	3.05
8	.....	4.45	4.35	3.65	3.1	2.85	3.05	23	4.4	4.95	3.9	3.85	2.8	3.55	3.05
9	.....	4.35	4.3	3.6	3.0	2.8	3.0	24	4.5	5.0	3.8	3.8	2.8	3.2	3.0
10	.....	4.75	4.25	3.6	2.9	2.8	3.0	25	4.6	5.05	3.85	3.7	2.8	3.25	3.2
11	.....	5.1	4.3	3.7	2.9	2.8	3.0	26	4.45	4.85	3.75	3.6	2.8	3.2	3.2
12	.....	5.1	4.2	3.7	2.9	2.9	3.1	27	4.3	4.95	3.75	3.6	2.9	3.2	3.2
13	.....	5.1	4.2	3.55	2.9	2.9	3.2	28	4.2	5.0	3.65	3.5	2.9	3.15	3.2
14	.....	5.15	4.2	3.5	2.9	2.9	3.2	29	4.1	4.8	3.65	3.45	2.9	3.2	3.3
15	.....	5.25	4.5	3.45	2.9	2.9	3.2	30	4.0	4.7	3.8	3.4	2.9	3.15	3.3
								31	4.15	.....	[b]5.15	3.4	.....	3.15	.....

[a] Gage heights for 1908 refer to new gage.
[b] Maximum gage height, July 31, 1908, was about 6.8 feet.

Rating tables for Arkansas River at Canon City, Colo.

MAY 1, 1907, TO JULY 27, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	390	4.40	1,080	5.30	2,110	6.20	3,601
3.60	454	4.50	1,175	5.40	2,252	6.30	3,794
3.70	521	4.60	1,274	5.50	2,400	6.40	3,992
3.80	591	4.70	1,377	5.60	2,554	6.50	4,194
3.90	664	4.80	1,485	5.70	2,714	6.60	4,400
4.00	740	4.90	1,598	5.80	2,880	6.70	4,606
4.10	819	5.00	1,717	5.90	3,052	6.80	4,812
4.20	902	5.10	1,842	6.00	3,230	6.90	5,018
4.30	989	5.20	1,973	6.10	3,413	7.00	5,224

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1906–7 and the form of previous curves and is not well defined.

JULY 28, 1907, TO NOVEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.70	131	3.60	474	4.50	1,045	5.40	1,962
2.80	165	3.70	520	4.60	1,132	5.50	2,080
2.90	200	3.80	569	4.70	1,223	5.60	2,200
3.00	236	3.90	622	4.80	1,318	5.70	2,321
3.10	273	4.00	680	4.90	1,417	5.80	2,443
3.20	311	4.10	743	5.00	1,520	5.90	2,566
3.30	350	4.20	811	5.10	1,626	6.00	2,690
3.40	390	4.30	884	5.20	1,735	6.20	2,941
3.50	431	4.40	962	5.30	1,847		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908–9 and is well defined.

Monthly discharge of Arkansas River at Canon City, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May	2,330	390	962	59,200	A.
June	4,400	1,080	2,750	164,000	B.
July	5,120	1,840	3,230	199,000	A.
August	1,960	743	1,170	71,900	A.
September	1,000	544	653	38,900	A.
The period				533,000	
1908.					
May 21–31	1,130	680	887	19,400	A.
June	1,900	884	1,370	81,500	A.
July	1,680	497	839	51,600	A.
August	1,370	390	566	34,800	A.
September	350	148	220	13,100	B.
October	452	165	248	15,200	B.
November	350	236	290	17,300	B.
The period				233,000	

ARKANSAS RIVER AT PUEBLO, COLO.

This station was established September 30, 1894, at the Santa Fe Avenue Bridge, Pueblo, Colo. On July 10, 1898, another gage was established on the east side of Main Street Bridge, which was used until March 3, 1900. Then a staff gage fastened to the retaining wall, a short distance below the Union Avenue Bridge, was used to July 14, 1902. From July 14, 1902, until July 7, 1905, readings were taken at a rod gage, having a different datum, located just above this bridge. The present chain gage on the Main Street Bridge has been in use since July 7, 1905.

As this station is near the head of the principal irrigated portion of the Arkansas Valley and above the head gates of the larger canals, the data are especially valuable to water superintendents and the state water commissioners in making distribution of water to the canals below.

No important tributaries enter within several miles above the station. Fountain Creek enters just below, and the Huerfano, the most important tributary in that vicinity, comes in about 20 miles below.

At various points above this station water is diverted for the irrigation of about 70,000 acres of land. The diversion for the Pueblo water supply also takes out above. Additional filings for irrigation above this station on the Arkansas are impossible, except for storage on some of the minor tributaries.

Slush and flowing ice are usually found at this station during the winter months and sometimes the river is frozen over or affected by ice jams below, but the results are rarely influenced by ice conditions for more than two months during the year. As noted above, numerous changes have been made in the datum of the gage.

Very good measurements can be obtained at this point, although the channel sometimes shifts considerably during floods.

Discharge measurements of Arkansas River at Pueblo, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 9	R. I. Meeker	59	106	2.10	225
March 27	do	150	164	2.70	591
May 6	C. L. Chatfield	149	170	2.70	614
May 24	do	150	376	4.10	2,290
June 17	W. B. Freeman	150	468	4.75	2,850
June 25	do	150	443	4.49	2,700
July 3	do	144	622	5.47	4,170
July 21	do	150	385	3.85	1,880
August 5	C. L. Chatfield	150	352	3.58	1,670
September 24	Freeman and Stewart	148	211	2.59	697
1908.					
February 14	J. B. Stewart	124	130	2.05	308
March 21	do	119	123	1.99	260
April 14	do	131	174	2.34	504
May 20	W. B. Freeman	124	160	2.35	424
May 30	J. B. Stewart	151	241	2.78	775
June 13	do	151	379	3.70	1,750
June 29	do	151	338	3.48	1,430
July 15	do	150	418	3.95	1,980
July 27	G. J. Lyon	144	171	2.45	431
September 25[a]	W. B. Freeman	63	45.0	1.60	43.0
November 20[a]	Thomas Griere	.....	115	2.20	284
November 21[a]	do	.....	88.0	1.97	181
November 22[a]	G. J. Lyon	118	107	2.00	188
November 25[a]	W. B. Freeman	117	98.5	1.97	178

[a] Measurements made at different section.

Daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1907 and 1908.

[David J. Cox, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	1.85	2.35	2.50	3.75	5.60	3.90	2.98	2.52	2.30	2.15
2	.....	1.68	2.10	2.50	3.45	5.70	3.78	2.82	2.42	2.30	2.15
3	.....	1.62	1.98	2.55	3.40	5.35	4.10	2.60	2.40	2.30	2.15
4	.....	2.00	2.08	2.55	3.82	5.35	3.80	2.50	2.42	2.22	2.10
5	.....	1.65	2.20	2.52	3.88	5.35	3.62	2.58	2.38	2.20	2.12
6	.....	1.65	2.22	2.68	4.25	5.50	3.40	2.65	2.40	2.20	2.28
7	.....	1.65	2.15	2.75	4.28	5.28	3.22	2.62	2.40	2.18	2.28
8	.....	1.80	2.10	2.98	4.15	5.15	3.15	2.55	2.45	2.20	2.30
9	.....	2.05	2.00	2.80	4.15	5.05	3.05	2.58	2.52	2.20	2.25
10	.....	2.08	1.92	2.65	4.05	5.20	2.90	2.52	2.42	2.20	2.28
11	.....	1.90	1.95	2.50	3.80	5.05	2.95	2.45	2.38	2.22	2.30
12	2.25	2.05	2.10	2.50	3.75	4.65	2.88	2.42	2.38	2.18	2.38
13	2.25	2.20	2.30	2.60	4.00	4.40	3.00	2.45	2.38	2.10	2.35
14	2.22	2.18	2.50	2.62	4.20	4.70	3.08	2.42	2.38	2.10	2.30
15	2.22	2.12	2.50	2.75	4.60	4.95	3.12	2.48	2.38	2.20	2.28
16	2.22	2.00	2.48	2.82	4.85	4.40	3.10	2.70	2.40	2.20	2.22
17	2.12	2.05	2.50	2.85	4.80	4.15	3.05	2.65	2.38	2.20	2.20
18	2.12	2.02	2.40	2.70	4.95	4.00	2.88	2.65	2.32	2.25	2.30
19	2.08	2.10	2.40	2.85	4.95	3.95	2.72	2.70	2.32	2.22	2.12
20	2.08	2.40	2.55	2.95	5.05	3.92	2.72	2.70	2.45	2.20	2.10
21	2.08	2.40	2.50	3.20	4.55	3.85	2.88	2.70	2.58	2.20	2.20
22	2.02	2.70	2.50	3.80	4.50	3.95	2.80	2.60	2.52	2.20	2.25
23	2.00	2.80	2.55	4.00	4.35	3.85	2.85	2.60	2.42	2.20	2.30
24	2.05	2.82	2.50	4.20	4.50	3.65	2.80	2.62	2.32	2.20	2.30
25	1.98	2.68	2.50	4.10	4.60	3.55	2.80	2.60	2.55	2.20	2.25
26	1.85	2.62	2.52	3.85	4.95	4.25	2.80	2.65	2.50	2.20	2.15
27	1.85	2.62	2.50	3.70	5.05	4.45	2.85	2.55	2.48	2.15	2.25
28	1.85	2.60	2.40	3.60	5.20	5.75	2.85	2.45	2.55	2.15	2.22
29	.....	2.65	2.40	3.60	5.35	4.45	2.80	2.40	2.60	2.15	2.22
30	.....	2.50	2.45	3.72	5.60	4.28	2.78	2.38	2.40	2.15	2.20
31	.....	2.50	.....	3.82	.....	3.95	3.20	.....	2.35	.....	2.15

Daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1907 and 1908—Con.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.											
1	.....	.....	1.8	1.9	2.85	3.25	3.8	2.15	1.9	2.2	.....
2	.....	.....	1.75	1.8	2.9	3.2	2.9	2.1	1.85	2.2	.....
3	.....	.....	1.75	1.8	2.8	3.1	3.0	2.0	1.8	2.2	.....
4	.....	.....	1.7	1.8	2.75	3.05	2.9	1.9	1.7	2.2	.....
5	.....	.....	1.75	2.0	3.05	3.05	2.65	1.85	1.85	2.2	.....
6	.....	.....	1.8	1.9	3.0	3.1	2.5	1.8	2.0	2.15	.....
7	.....	.....	1.8	1.9	3.1	3.1	2.9	1.75	2.0	2.2	.....
8	.....	.....	2.05	1.9	2.0	3.05	2.55	1.7	2.0	2.2	.....
9	.....	.....	2.3	1.8	2.9	2.95	2.35	1.65	2.0	2.2	.....
10	.....	2.1	2.35	1.85	3.0	2.9	2.3	1.6	1.95	2.2	.....
11	.....	2.0	2.4	2.0	3.5	2.9	2.25	1.55	2.0	2.15	.....
12	.....	1.9	2.4	2.0	3.65	3.2	2.5	1.75	2.05	2.2	.....
13	.....	2.0	2.4	2.0	3.6	2.85	2.35	1.8	2.0	2.2	.....
14	.....	1.9	2.4	2.05	3.55	2.9	2.35	1.75	2.0	2.2	.....
15	.....	1.9	2.4	2.1	3.9	3.5	2.3	2.6	2.0	2.2	.....
16	.....	1.95	2.4	1.9	3.9	3.35	2.65	1.8	2.0	2.2	.....
17	.....	2.0	2.45	2.2	3.4	3.4	2.4	1.7	2.0	2.3	.....
18	.....	2.0	2.4	2.3	3.65	3.05	2.2	1.8	2.1	2.25	.....
19	.....	2.0	2.3	2.35	3.8	3.6	2.35	1.8	2.2	2.2	.....
20	.....	1.95	2.35	2.45	3.4	3.1	2.55	1.75	2.25	2.2	.....
21	.....	2.0	2.4	2.75	3.1	2.95	2.65	1.75	2.2	2.0	.....
22	.....	1.9	2.3	2.9	3.2	2.9	2.9	1.7	2.3	1.95	.....
23	.....	1.95	2.35	3.0	3.45	2.8	3.05	1.6	2.5	2.0	.....
24	.....	1.9	2.4	3.2	3.5	2.8	2.7	1.7	2.4	1.95	.....
25	.....	1.9	2.4	3.2	3.5	2.6	2.55	1.7	2.2	2.0	.....
26	.....	1.9	2.4	3.1	3.5	2.6	2.35	1.65	2.25	2.1	.....
27	.....	1.9	2.35	3.05	3.35	2.45	2.45	1.9	2.2	2.05	.....
28	.....	1.9	2.1	2.95	3.55	2.3	2.4	1.95	2.2	2.0	.....
29	.....	1.95	2.0	2.85	3.5	2.2	2.35	1.9	2.2	2.2	.....
30	.....	1.9	2.0	2.8	3.3	3.0	2.3	1.9	2.2	2.25	.....
31	.....	1.8	.....	2.75	.....	2.65	2.3	.....	2.2	.....	.....

NOTE.—November 26–27, 1908, river contained floating slush ice.

Rating tables for Arkansas River at Pueblo, Colo.

JANUARY 1 TO JUNE 30, 1907; ALSO JULY 15 TO NOVEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	10	2.50	450	3.50	1,390	4.50	2,725
1.60	40	2.60	520	3.60	1,510	4.60	2,870
1.70	70	2.70	595	3.70	1,630	4.70	3,015
1.80	105	2.80	675	3.80	1,755	4.80	3,160
1.90	140	2.90	760	3.90	1,890	4.90	3,310
2.00	180	3.00	850	4.00	2,025	5.00	3,460
2.10	225	3.10	945	4.10	2,160	5.20	3,760
2.20	270	3.20	1,050	4.20	2,295	5.40	4,075
2.30	325	3.30	1,160	4.30	2,435	5.60	4,400
2.40	385	3.40	1,275	4.40	2,580		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during the above periods and the high water measurements above gage height 5.0 feet. It is well defined between gage heights 2.0 feet and 5.0 feet.

JULY 1, 1907, TO APRIL 27, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	120	2.70	785	3.70	1,795	4.60	2,880
1.80	165	2.80	870	3.80	1,905	4.70	3,020
1.90	215	2.90	960	3.90	2,015	4.80	3,165
2.00	270	3.00	1,055	4.00	2,130	4.90	3,310
2.10	330	3.10	1,155	4.10	2,245	5.00	3,460
2.20	395	3.20	1,260	4.20	2,365	5.20	3,760
2.30	465	3.30	1,365	4.30	2,490	5.40	4,075
2.40	540	3.40	1,470	4.40	2,620	5.60	4,395
2.50	620	3.50	1,575	4.50	2,750	5.80	4,725
2.60	700	3.60	1,685				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during the above period and is well defined between gage heights 1.9 feet and 5.5 feet.

Rating tables for Arkansas River at Pueblo, Colo.—Continued.

APRIL 28 TO MAY 16, 1908.

[The indirect method for shifting channels used.]

MAY 17 TO JULY 14, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	220	2.50	535	3.00	975	3.50	1,480
2.10	270	2.60	615	3.10	1,070	3.60	1,590
2.20	325	2.70	700	3.20	1,170	3.70	1,700
2.30	390	2.80	790	3.30	1,270	3.80	1,815
2.40	460	2.90	880	3.40	1,375	3.90	1,930

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and the general form of previous curves and is well defined.

Daily discharge, in second-feet, of Arkansas River at Pueblo, Colo., April 28–May 16, 1908.

Day.	April.	May.	Day.	April.	May.	Day.	April.	May.
1		180	11		225	21		
2		140	12		215	22		
3		138	13		205	23		
4		135	14		230	24		
5		250	15		260	25		
6		170	16		160	26		
7		168	17			27		
8		165	18			28	300	
9		130	19			29	250	
10		150	20			30	250	
						31		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Arkansas River at Pueblo, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
February 12–28	298	122	216	7,280	C.
March	692	46	302	18,600	B.
April	485	148	349	20,800	B.
May	2,300	450	998	61,400	A.
June	4,400	1,280	2,640	157,000	A.
July	4,640	1,630	3,000	184,000	A.
August	2,240	802	1,160	71,300	A.
September	1,040	525	691	41,100	A.
October	700	480	566	34,800	A.
November	465	330	395	23,500	A.
December	525	330	416	25,600	B.
The period				645,000	
1908.					
March 10–31	330	165	238	10,400	B.
April	580	120	402	23,900	A.
May	1,170	130	480	29,500	B.
June	1,930	745	1,280	76,200	A.
July	1,510	270	898	55,200	A.
August	1,760	270	531	31,600	A.
September	520	25	118	7,020	C.
October	450	70	221	13,600	B.
November	298	160	249	14,300	B.
The period				262,000	

ARKANSAS RIVER AT LA JUNTA, COLO.

This station, which was established in August, 1908, and discontinued November 30, 1908, was located at the highway bridge about one-half mile northwest of the Atchison, Topeka and Santa Fe Railway depot at La Junta, Colo. The locality is a short distance below the mouth of Crooked Arroyo and some 20 miles above the mouth of Purgatory River.

The records furnish general information of much value. A considerable portion of the flow of Arkansas River is diverted for irrigation above.

The gage is one that has been used at different times by the division engineer of irrigation, division No. 2 of Colorado. The United States Geological Survey has had fragmentary records at La Junta in several different years, but there seems to be very little connection between them. The 1903 records were taken at a bridge about a mile and a half farther east.

The stream bed shifts, and as only a few measurements were taken during 1908, it has not been possible to make reliable estimates of the daily discharge.

Discharge measurements of Arkansas River at La Junta, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
June 13	G. J. Lyon	153	197	2.10	492
July 22	do	67	71.7	1.30	101
August 27	do	68	117	1.70	120
October 3	W. B. Freeman				[b] 15
October 24 [a]	Freeman and Lyon	20	13.8	1.05	15.7

[a] Wading measurement. [b] Estimated.

Daily gage height, in feet, of Arkansas River at La Junta, Colo., for 1908.

[Thomas J. Alliston, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		1.1	1.15	1.7	16		1.0	.3	2.1
2		1.2	1.0	1.8	17		1.05	.2	2.0
3		1.1	1.0	1.5	18		1.0	.9	2.0
4		1.2	1.05	1.5	19		1.05	4.85	1.5
5		1.1	1.1	1.5	20		1.15	2.1	1.75
6		1.15	1.15	1.5	21		1.15	1.7	1.5
7		1.0	1.4	2.0	22		1.5	1.7	1.5
8		1.0	1.25	1.75	23		1.2	1.5	1.5
9		1.1	1.15	1.5	24		1.05	1.5	1.75
10		1.2	.5	1.5	25		1.2	1.5	1.75
11		1.3	.4	1.75	26		1.15	2.1	1.5
12		1.15	.7	1.5	27	1.5	1.2	2.0	1.5
13		1.15	1.2	1.75	28	1.55	1.2	2.0	1.5
14		1.2	.7	2.0	29	1.25	1.2	2.0	1.5
15		1.15	.3	2.0	30	1.2	1.2	2.0	1.75
					31	1.2		2.0	

ARKANSAS RIVER AT HOLLY, COLO.

This station, which was established October 15, 1907, is located at the pile highway bridge one-half mile southeast of Holly, Colo., about 4 miles above the Colorado-Kansas line.

As no important diversions are made between the two points the data obtained at this station have special value as showing the amount of surface water passing from Colorado to Kansas.

The station is just above the mouth of Wild Horse Creek and about 1 mile below the mouth of Two Butte Creek. The drainage area is about 25,000 square miles.

As nearly a half million acres of land are under irrigation above this point most of the ordinary flow of the stream is diverted during the irrigation season, while during the winter months it is used to fill up the numerous storage reservoirs in the basin. Except during periods of heavy flood, the flow at Holly consists chiefly of return waters. The stream flow is little affected by ice.

The gage heights here published have all been referred to the same datum, though a rod gage at a different datum was used during part of 1908.

Fairly good measurements can be taken at this point, but in order to obtain accurate records of daily discharge it is necessary to take them frequently on account of the extremely shifting character of the channel.

Discharge measurements of Arkansas River at Holly, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 15	W. B. Freeman	144	45	2.00	68
October 15	do	102	50	1.96	95
1908.					
March 24	J. B. Stewart	130	51.0	2.18	64
June 13	G. J. Lyon	93	48.6	2.25	67
July 20	do	142	50.8	2.00	56
July 21	do	513	300	2.85	511
July 23	C. W. Beach		50.0	2.29	97
August 26	G. J. Lyon	473	362	3.10	55
October 25	Freeman and Lyon	292	380	1.05	1,020

Daily gage height, in feet, of Arkansas River at Holly, Colo., for 1907 and 1908.

[Fred Gores, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1907.				1907.				1907.			
1		2.00	2.10	11		2.00	2.20	21	1.80	2.20	2.00
2		2.00	2.30	12		2.25	2.25	22	1.80	2.10	2.00
3		2.00	2.28	13		2.20	2.20	23	1.80	2.10	2.00
4		2.00	2.10	14		2.15	2.15	24	1.80	2.20	2.05
5		2.00	2.00	15	1.95	2.10	2.12	25	2.00	2.25	2.15
6		2.00	2.00	16	1.98	2.15	2.05	26	1.95	2.25	2.38
7		1.95	2.00	17	2.15	2.15	2.00	27	1.95	2.20	3.00
8		1.95	2.10	18	2.10	2.15	2.05	28	1.95	2.20	2.92
9		1.95	2.00	19	2.00	2.30	2.00	29	2.10	2.15	3.00
10		2.10	2.12	20	1.80	2.30	2.10	30	2.10	2.15	3.00
								31	2.10		2.95

Daily gage height, in feet, of Arkansas River at Holly, Colo., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	.....	2.0	1.85	1.8	2.15	3.0	3.5	.....	0.6	0.15
2	.....	2.0	1.85	1.8	2.0	3.0	2.7	.....	.6	.2
3	.....	1.9	1.85	1.8	1.85	2.7	.....	.....	.6	.2
4	.....	1.9	1.8	1.8	1.8	2.4	.....	0.4	.6	.2
5	.....	1.9	1.8	1.8	1.8	2.15	.....	.5	.6	.2
6	.....	1.9	1.8	1.8	1.8	1.85	.....	.5	.6	.2
7	.....	1.95	1.8	3.1	1.7	1.8	.....	.5	.6	.2
8	.....	1.95	1.8	3.1	1.7	1.7	.....	.45	.6	.25
9	.....	1.9	1.8	3.1	1.7	1.7	.....	.5	.6	.25
10	.....	1.9	1.8	3.1	1.7	1.7	.....	.5	.6	.3
11	2.3	1.9	1.8	3.2	1.7	1.7	.....	.5	.55	.3
12	2.5	1.9	1.8	2.85	1.7	1.65	.....	.5	.5	.3
13	2.35	1.9	1.8	2.2	1.7	1.65	.....	.5	.5	.3
14	2.4	1.9	1.9	2.0	1.7	1.7	.....	.5	.5	.3
15	2.2	1.9	1.9	1.85	1.7	1.7	.....	.6	.4	.3
16	.....	1.9	1.9	4.0	1.7	2.3	.....	.6	.4	.3
17	.....	1.9	1.9	4.25	1.7	2.2	.....	.5	.4	.3
18	.....	1.9	1.9	4.2	2.0	2.1	.....	.6	.3	.3
19	.....	1.9	1.9	2.2	2.5	2.65	.....	7.1	.2	.3
20	.....	1.9	1.9	1.8	2.2	2.65	.....	10.3	.2	.3
21	.....	1.9	1.9	1.8	2.75	3.25	.....	4.3	.15	.3
22	.....	1.85	1.9	1.8	2.4	3.6	.....	3.0	.1	.3
23	.....	1.85	1.85	1.8	2.1	3.25	.....	3.0	.1	.3
24	2.1	1.85	1.9	1.8	2.05	3.2	.....	3.0	.2	.4
25	2.1	1.85	1.9	1.8	2.1	3.35	.....	1.05	.15	.4
26	2.1	1.85	1.9	3.7	2.6	3.3	.....	1.1	.1	.45
27	2.1	1.85	1.8	4.2	2.85	3.3	.....	1.0	.1	.45
28	2.1	1.85	1.8	3.2	2.7	2.95	.....	.9	.2	.45
29	2.1	1.85	1.8	1.85	2.2	3.9	.....	.9	.2	.45
30	2.1	1.85	1.8	1.8	2.05	3.85	.....	.7	.2	.45
31	2.0	.....	1.8	.....	2.0	3.6	.....	.7	.....	.45

NOTE.—Water away from the gage March 16–23, September 3–October 3, 1908.

GRAPE CREEK AND DE WESSE-DYE DITCH NEAR CANON CITY, COLO.

This station was established July 24, 1907, primarily to determine the amount of flood waters available for storage. Two gages have been used, which have been called the upper and the lower gages. The lower gage, at which daily gage readings have been made, was established because of its accessibility. It is located about 150 yards above the junction of the creek with the Arkansas River, some distance below the head of the De Wesse-Dye ditch, which has a capacity of about 25 second-feet. The upper gage is located about 1½ miles above the mouth of the stream, and 200 yards above the headgates of the De Wesse-Dye ditch. At high water discharge measurements are made at the upper gage, and the discharge of the De Wesse-Dye ditch is subtracted to show the flow past the lower gage.

No important tributaries enter below the upper gage. Pine Creek enters a few miles above.

Considerable irrigation is practiced above this station in the vicinity of Silver Cliff, and a storage reservoir is also used to regulate the supply of water for the De Wesse-Dye ditch.

No change has been made in the datum of either gage since the station was established.

High velocities, the character of the stream bed, and the shifting nature of the channel during flood make it difficult to obtain accurate measurements. Moreover, the stream is subject to very rapid rises and subsides just as suddenly, so that an automatic register is necessary to record the changes in the gage heights.

The flow is usually very small during the winter months except when a flood occurs, so that ice conditions have very little influence on the flow.

Discharge measurements of Grape Creek near Canon City, Colo., in 1907 and 1908.

[Upper gage.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 31[a]	J. B. Stewart	11.5	8.5	1.01	14.8
1908.					
February 14[a]	J. B. Stewart	17.5	15.0	[b].99	4.2
March 22[a]	do	36	28.0	1.00	59
April 14[a]	do	13.5	12.4	.68	21.5
May 20[a]	W. B. Freeman	16	10.2	.60	18.7
June 13[a]	J. B. Stewart	18	11.8	.65	18
July 15	do		118	3.50	[c]650
July 16[a]	do	29	14.9	1.00	22.4
November 21[a]	G. J. Lyon	32	15.2	.60	27.8

[a] Made by wading at various sections in the vicinity of the gage.
[b] Gage height distorted. Ice 1 foot thick along edges of creek.
[c] Estimated by Kutter's formula.

Discharge measurements of De Wesse-Dye ditch near Canon City, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 14[a]	J. B. Stewart				0
March 22[b]	do	7	7		11
April 14[b]	do	6.8	8		18.2
May 20	W. B. Freeman	7.2	8.2	0.97	18.9
June 13	J. B. Stewart			.99	[c]17
July 16	do			1.10	[d]20.4
November 21	G. J. Lyon				[d]23.2

[a] Ditch dry. [b] Made by wading. [c] Estimated.
[d] Computed from difference in discharges at the two stations on Grape Creek, Colo., on this date.

Discharge measurements of Grape Creek near Canon City, Colo., in 1907 and 1908.

[Lower gage.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 23	W. B. Freeman	10.5	22.5	1.15	73
August 14	do	38	26.0	1.60	86
September 25[a]	Freeman and Stewart	21	9.2	1.42	28
November 1[a]	J. B. Stewart	13.5	3.8	1.15	2.7
1908.					
February 14[b]	J. B. Stewart				4.2
March 22	do			2.20	[c]48.0
April 14	do			1.55	[c]3.3
May 20	W. B. Freeman			1.45	[d]1.0
June 13	J. B. Stewart			1.55	[d]1.0
July 15	do		118	3.50	[e]650
July 16	do			1.60	[d]2.0
November 21[a]	G. J. Lyon	12	2.2	1.55	4.6

[a] Made by wading near gage.
[b] From February 11–23, 1908, water was diverted by a cofferdam while a headgate a short distance below lower gage was being repaired. As the water was not used, the effect was same as if it actually passed the lower gage, and it should be estimated. Measurement on February 14, 1908, shows the amount of water which would have passed the lower gage.
[c] Computed from sum of discharges at upper gage and in the ditch.
[d] Estimated. [e] Estimated by Kutter's formula.

Daily gage height, in feet, of Grape Creek near Canon City, Colo., for 1907 and 1908.

[S. R. McKissick, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1		1.95	1.5	1.3	1.15	1.35	16		1.6	1.55	1.3	1.4	1.7
2		1.95	1.5	1.3	1.25	1.35	17		1.6	1.55	1.3	1.3	1.65
3		1.95	1.5	1.3	1.2	1.3	18		1.6	1.55	1.3	1.4	1.7
4		2.0	1.55	1.3	1.15	1.4	19		1.6	1.55	1.3	1.45	1.6
5		1.95	1.7	1.3	1.1	1.4	20		1.5	1.5	1.35	1.4	1.7
6		1.65	1.55	1.3	1.05	1.4	21		1.5	1.5	1.35	1.4	1.7
7		1.65	1.5	1.3	1.25	1.45	22		1.5	1.45	1.3	1.35	1.85
8		1.65	1.5	1.3	1.25	1.4	23	1.15	1.5	1.45	1.25	1.2	1.95
9		1.65	1.5	1.3	1.25	1.35	24	.95	1.45	1.4	1.3	1.2	1.95
10		1.65	1.55	1.3	1.25	1.4	25	1.98	1.45	1.4	1.35	1.4	1.85
11		1.6	1.55	1.3	1.4	1.4	26	1.1	1.5	1.4	1.35	1.4	1.85
12		1.65	1.55	1.3	1.35		27	1.1	1.5	1.35	1.3	1.4	1.8
13		1.65	1.55	1.3	1.2	1.55	28	[a]3.0	1.55	1.35	1.25	1.45	1.8
14		1.6	1.5	1.3	1.2	1.7	29	2.1	1.5	1.3	1.3	1.4	1.75
15		1.6	1.5	1.3	1.4	1.5	30	2.1	1.55	1.3	1.3	1.4	1.7
							31	1.9	1.45		1.3		1.6

Day.	Jan.	Feb.[b]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.											
1	1.8	1.35	2.0	1.6	1.6	1.5	1.55	1.4	1.3	1.6	1.6
2	1.75	1.6	2.0	1.65	1.6	1.7	1.5	1.4	1.35	1.7	1.6
3	1.9	1.95	2.0	1.6	1.55	1.6	1.5	1.5	1.3	1.5	1.5
4	2.1	2.0	2.1	1.6	2.0	1.55	1.5	1.5	1.6	1.5	1.55
5	2.0	1.9	2.2	1.6	2.05	1.55	1.5	1.4	1.6	1.5	1.55
6	1.9	1.7	2.4	1.6	1.75	1.55	1.5	1.4	1.5	1.9	1.5
7	1.55	1.8	2.1	1.6	1.7	1.65	1.5	1.4	1.5	1.6	1.5
8	1.45	1.95	1.9	1.55	1.7	1.6	1.5	1.4	1.5	1.6	1.5
9	1.6	1.8	1.85	1.55	1.7	1.6	1.5	1.3	1.5	1.6	1.55
10	1.5	1.45	1.9	1.55	1.55	1.6	1.5	1.3	1.5	1.6	1.6
11	1.45		1.85	1.55	1.6	1.6	2.3	1.3	1.5	1.6	1.6
12	1.7		[c]2.3	1.65	1.6	1.55	1.6	1.6	1.5	1.6	1.7
13	1.55		[c]2.35	1.6	1.5	1.55	1.65	1.5	1.5	1.6	1.8
14	1.7		[c]2.25	1.55	1.5	1.6	1.6	1.4	1.5	1.65	1.7
15	2.0		2.3	1.55	1.5	1.6	2.4	1.4	1.5	1.65	1.6
16	1.7		2.2	1.55	1.5	1.6	1.6	1.3	1.5	1.6	1.5
17	1.9		2.1	1.6	1.5	1.55	1.6	1.4	1.5	1.6	1.5
18	1.7		2.1	1.6	1.5	1.55	1.6	1.4	1.5	1.7	1.5
19	1.9		2.2	1.6	1.5	1.55	1.7	1.7	1.5	1.7	1.8
20	1.9		2.2	1.6	1.45	1.55	1.6	1.5	1.5	1.7	1.55
21	1.8		2.2	1.6	1.45	1.55	1.6	1.45	1.5	1.65	1.55
22	1.8		2.2	1.6	1.45	1.55	1.5	1.5	1.5	1.65	1.85
23	1.75		2.2	1.6	1.5	1.55	1.5	1.5	1.5	1.5	1.8
24	1.7	1.9	2.2	1.55	2.0	1.55	1.5	1.5	1.5	1.65	1.5
25	1.85	1.65	2.2	1.6	2.0	1.55	1.5	1.5	1.5	1.7	1.9
26	1.9	1.65	2.2	1.6	1.9	1.55	1.5	1.4	1.5	1.55	1.85
27	1.7	1.8	1.8	1.55	1.5	1.55	1.7	1.4	1.5	1.5	1.8
28	1.7	2.0	1.75	1.55	1.45	1.55	1.4	1.4	1.7	1.85	1.6
29	1.55	2.0	1.7	1.85	1.45	1.55	1.4	1.35	1.7	1.5	1.55
30	1.4		1.65	1.6	1.5	1.55	1.5	1.35	1.6	1.5	1.9
31	1.55		1.6		1.5		1.4	1.3		1.55	

[a] Maximum gage height July 28, 1907, was 6.0 feet.
[b] Water temporarily diverted from gage February 11–23, 1908.
[c] Gage heights for March 12, 13, 14, 1908, probably affected by backwater caused by construction of a wing dam by South Canyon Ditch Company to divert water from Grape Creek into South Canyon ditch.

HUERFANO RIVER NEAR UNDERCLIFFE, COLO.

This station, which was established July 31, 1908, and discontinued December 31, 1908, was located at the Doyle ranch bridge, on the old government road from Pueblo to Trinidad, in the SE. $\frac{1}{4}$ sec. 11, T. 23 S., R. 63 W., and about 4 miles south of Undercliffe post-office.

The records are valuable chiefly because they show the amount of water available for storage on the river.

Cucharas River, the most important tributary, enters a few miles above the station. There are no important diversions below. In all, about 25,000 acres are being irrigated from Cucharas and Huerfano rivers. Excellent storage sites, some of which are now being developed, are found on both of these streams.

The datum of the gage remained constant during the period the station was in operation. Unfortunately, not enough discharge measurements were taken to form a basis for accurate computations of the daily discharge.

The following discharge measurement was made July 31, 1908:

Width, 30 feet; area, 16.5 square feet; gage height, 1.65 feet; discharge, 42.2 second-feet.

Daily gage height, in feet, of Huerfano River near Undercliffe, Colo., for 1908.

[C. T. Vertrees, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05					16					
2	1.9					17	4.4				
3	1.5					18	2.9				
4	1.0					19	2.1				
5					0.5	20	3.5				
6					.2	21	2.85				
7	2.6				.1	22	3.1				
8	1.2				.6	23	2.25				
9					.6	24	2.6				
10					.3	25	2.4				
11	[a]5.0				.3	26	2.0				
12	2.0				.3	27	2.0				
13	1.4					28					
14	1.2					29					
15						30					
						31					

[a] Crest height of flood.

NOTE.—The stream was dry on those days between August 1 and December 31, for which no gage reading is given.

CUCHARAS RIVER AT WALSENBURG, COLO.

This station, which was established May 6, 1907, and abandoned November 13, 1908, was located at the steel highway bridge on Main street, one-half mile southeast of the court-house at Walsenburg, Colo.

The locality is about a mile above the mouth of Bear Creek and 20 miles above the junction of the Cucharas and Huerfano.

As practically all the normal and low-water flow of the stream is diverted for irrigation above this point, the records are valuable only to determine the discharge of the river.

No winter records have been kept, but ice conditions usually prevail for several months. No change was made in the datum of the gage during the maintenance of the station.

The results obtained here have been very unsatisfactory, because of the shifting nature of the channel and the fact that no high-water measurements were made.

Discharge measurements of Cucharas River at Walsenburg, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 28	R. I. Meeker	14	3.8	(a)	4.2
May 6	C. L. Chatfield	39	37.0	2.30	132
May 24	do	40	62.0	2.50	271
June 15	do	37	29.0	1.45	62.0
July 21 [b]	W. B. Freeman	6	2.5	.55	4.5
August 5	C. L. Chatfield	43	42.0	1.20	78.0
1908.					
March 26	J. B. Stewart	9	.6	.75	[c] 1.0
May 29	do			.69	[c] .8
June 29	do				[c] .8
November 25	W. B. Freeman				[c] .5

[a] No gage established. [b] Float measurement, 50 feet downstream. [c] Estimated.

Daily gage height, in feet, of Cucharas River at Walsenburg, Colo., for 1907 and 1908.

[Bolden Harrison, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								1908.							
1	.....	2.57	0.52	1.18	1.14	.....	1.05	1	.....	0.7	0.7	0.85	1.4	.....	.....
2	.....	2.78	.48	1.18	1.11	.....	1.05	2	.....	.65	.75	.9	1.35	.....	.....
3	.....	3.08	.66	1.42	1.18	.....	1.13	3	.....	.7	.7	.9	1.3	.....	.....
4	.....	3.15	.62	1.31	1.16	.....	.....	4	.....	.8	.....	.8	1.2	.....	.....
5	.....	2.90	.60	1.30	1.18	.....	.....	5	.....	1.0	.....	.7	1.1	.....	.....
6	2.30	2.65	.62	1.28	1.18	.....	.....	6	.....	1.1	.....	.8	.....	.....	.....
7	2.34	2.42	.54	1.22	1.21	.....	.....	7	.....	1.1	.....	.75	.....	.....	.....
8	2.36	2.28	.56	1.20	1.29	.....	.....	8	.....	1.55	.....	.69	.....	.....	.....
9	2.36	2.19	.64	1.02	1.23	.....	.....	9	.....	1.25	.....	.6	.....	.....	.....
10	2.34	2.40	.60	.89	1.26	.....	1.10	10	.....	.95	.....	.....	.....	1.0	.....
11	2.35	1.81	.51	.86	1.32	.....	1.10	11	.....	.85	.....	.....	.....	1.05	.....
12	2.40	1.68	.60	.85	1.47	.....	1.14	12	.....	.8	1.2	.....	.....	1.15	.....
13	2.44	1.56	.58	1.04	1.46	.....	1.12	13	.....	.8	1.0	.....	.....	1.1	.....
14	2.39	1.52	.62	1.04	1.40	.....	1.10	14	.....	.85	1.15	.....	.....	1.15	.....
15	2.31	1.40	.65	.94	1.36	.....	1.16	15	.....	.95	1.1	.75	.....	1.2	.....
16	2.29	1.32	.89	.86	1.46	.....	1.12	16	0.75	1.6	1.0	3.8	.....	1.2	.....
17	2.38	1.38	.81	.81	1.41	.....	.....	17	.8	1.1	.95	3.2	.....	1.15	.....
18	2.42	1.62	.22	.84	1.41	.....	.....	18	.85	1.15	.9	2.6	.....	1.1	.....
19	2.53	1.52	.44	.81	1.32	.....	.....	19	.8	1.75	.9	2.0	.....	1.15	.....
20	2.48	1.56	.66	.84	1.44	.....	.....	20	.8	.95	.9	2.2	.....	1.25	.....
21	2.56	1.48	.56	1.38	1.38	.....	.....	21	.85	.9	.8	1.55	.....	1.25	.....
22	2.56	1.42	.50	1.18	1.31	.....	.....	22	.8	.85	.8	1.65	.....	1.15	.....
23	2.54	1.42	.88	1.11	1.26	.....	.....	23	.8	.9	.79	1.6	.....	1.1	.....
24	2.44	1.40	.66	1.48	1.20	.....	.....	24	.....	.9	.8	1.85	.....	.....	.....
25	2.30	1.38	.58	1.55	1.28	.....	.....	25	.....	.85	.75	1.9	.....	.....	.....
26	2.14	1.18	1.70	1.60	1.27	.....	.....	26	.....	.8	.8	1.55	.....	.....	.....
27	2.30	1.25	1.11	1.65	1.22	.....	.....	27	.....	.....	.85	1.5	.....	.....	.....
28	1.98	1.20	1.18	1.04	1.20	.....	.....	28	.....	.....	.8	1.55	.....	.....	.....
29	1.99	1.02	.96	.89	1.20	.....	.....	29	.....	.7	.8	1.5	.....	.....	.....
30	2.38	.58	.94	.83	1.16	.....	.....	30	.7	.....	.8	1.4	.....	.....	.....
31	2.45	.....	1.04	1.11	.....	.....	.....	31	.7	.....	.8	1.45	.....	.....	.....

NOTE.—Stream dry October 1–31 and November 4–9, 1907. Gage heights May 24–29, 1908, missing because gage chain was stolen. Stream was dry on days in period June 27–November 13, 1908, when gage was not read.

PURGATORY RIVER DRAINAGE BASIN.

DESCRIPTION.

Purgatory River,[a] the principal tributary of Arkansas River in Colorado, rises in the Culebra Mountains and flows northeastward across the plains for a distance of 165 miles. In the spring the channel carries a moderate volume of water, but as summer approaches this is greatly diminished by irrigation and natural conditions until the channel is practically dry. The volume of water contributed to the Arkansas is so small that it has no appreciable effect on the discharge of that river except at times of excessive rainfall, when it may discharge a large volume for a short time.

The drainage basin of Purgatory River is long and narrow. The total area is 3,400 square miles. The 742 square miles lying above Trinidad are mountainous and the surface is much broken by stream channels, which are normally dry. The lower basin is foothill country, merging into rough plains farther east. Drainage lines are well defined throughout part of the area. For 60 miles of its length, commencing 25 miles below Trinidad, Purgatory River flows in a deep canyon. Many small tributary canyons enter at various angles to the main channel.

In the mountainous portion the Weather Bureau records at Clearview for fifteen years give a mean annual rainfall of 23 inches; at Trinidad, ten years' record, 17 inches. The plains drainage has approximately a mean annual precipitation of 12 inches.

No storage is practiced on this stream, though investigations are being made by a corporation with the purpose of constructing a large storage reservoir for use in irrigation. No power has been developed, and because of the abundance of coal in the vicinity of Trinidad it is doubtful if power development would be feasible, even under very favorable circumstances.

The basin contains about 100 square miles of merchantable timber land and a small amount of woodland, all of which is included in the Las Animas National Forest.

Some 20,000 acres of land is now being irrigated along Purgatory River.

[a] This stream is often termed Las Animas, especially along its lower course, and sometimes it is called Picket Wire.

PURGATORY RIVER NEAR TRINIDAD, COLO.

This station has been maintained at the Animas Street Bridge, Trinidad, Colo., from May 1, 1896, to July 31, 1899; from August 25, 1905, to December 31, 1905; from November 7, 1906, to March 10, 1907; and from October 14, 1907, to date.

The records furnish information as to flood discharge and are valuable also for irrigation projects.

The South Fork joins the upper Purgatory about 14 miles above Trinidad. Chaquaqua River, the first important tributary below, enters about 60 miles below Trinidad. Considerable water is being diverted for irrigation above the station and some below. No power has yet been developed from this stream.

The flow at this point is affected to some extent by ice conditions, though the winter discharge is usually small.

The datum of the present gage, which has been used since August 25, 1905, is 1.70 feet below the datum of the old rod gage formerly used.

Low-water measurements are usually taken by wading, but conditions for taking measurements at higher stages are not favorable. The stream bed is shifting in character.

Discharge measurements of Purgatory River near Trinidad, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5[a]	L. D. Bull	30	16	4.15	19
January 10[a]	do	27	13	4.02	14
January 19	do	28	15	4.10	18
January 30	do	29	17	4.20	24
February 6	do	29	14	4.05	17
October 14	W. B. Freeman	30	25.5	3.17	37
1908.					
March 25[a]	J. B. Stewart	25	13	3.15	17
May 29[a]	do	29	19.5	3.25	31
June 29[a]	do	30.5	25	3.37	41
July 17[a]	do	70	84.2	4.55	162
October 26[a]	W. B. Freeman	26.6	17.6	4.25	29.4
November 25[a]	do	28.6	17	4.18	23

[a] Made by wading.

Daily gage height, in feet, of Purgatory River near Trinidad, Colo., for 1907 and 1908.

[H. D. Albertson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.00	4.00	4.00								3.15	3.22
2	4.22	4.02	3.95								3.20	3.18
3	4.26	4.00	4.00								3.20	3.22
4	4.15	4.00	4.02								3.12	3.20
5	4.18	4.05	4.00								3.10	3.20
6	4.15	4.02	4.02								3.10	3.30
7	4.15	4.02	4.00								3.10	3.28
8	3.98	4.00	4.00								3.10	3.25
9	4.05	4.00	4.00								3.10	3.10
10	3.98	4.00	4.00								3.10	3.18
11	4.05	4.00									3.25	3.18
12	3.98	4.00									3.20	3.25
13	4.15	4.00									3.08	3.15
14	4.00	4.00								3.15	3.22	3.10
15	4.15	4.00								3.15	3.22	3.10
16	4.08	4.00								3.15	3.30	2.92
17	4.10	3.98								3.12	3.30	3.20
18	4.12	3.98								3.15	3.22	3.20
19	4.10	3.98								3.15	3.20	3.10
20	4.18	3.92								3.15	3.12	3.18
21	4.12	3.92								3.15	3.20	3.20
22	4.10	3.95								3.15	3.18	3.25
23	4.10	3.95								3.00	3.08	3.20
24	4.10	3.98								3.00	3.25	3.20
25	4.10	3.95								3.95	3.18	3.30
26	3.90	4.00								3.35	3.18	3.40
27	4.10	4.00								3.18	3.18	3.15
28	3.90	4.00								3.18	3.18	3.25
29	4.20									3.18	3.15	3.25
30	4.08									3.15	3.15	3.20
31	4.00									3.20		3.20
1908.												
1				3.0	3.35	3.1	3.3	5.25	4.5	4.2	4.1	
2				3.0	3.35	3.2	3.5	4.85	4.5	4.2	4.1	
3				3.0	3.35	3.2	3.75	4.8	4.5	4.15	4.0	
4				3.0	3.5	3.25	3.7	4.65	4.5	4.15	3.9	
5				3.0	3.55	3.3	3.5	4.6	4.45	4.2	3.9	
6				3.0	3.55	3.35	3.6	4.55	4.4	4.2	3.9	
7				2.95	3.5	3.35	3.3	4.55	4.4	4.2	3.9	
8				2.85	3.35	3.35	3.25	4.6	4.3	4.2	3.9	
9				2.8	3.35	3.35	3.2	4.5	4.3	4.2	3.9	
10			3.2	3.3	3.35	3.4	3.2	4.5	4.3	4.2	3.95	
11			3.2	3.4	3.5	3.4	3.6	4.6	4.3	4.2	3.95	
12			3.2	3.35	3.45	3.45	4.6	4.6	4.3	4.2	4.1	
13			3.2	3.35	3.4	3.55	4.65	4.6	4.25	4.2	4.05	
14			3.2	3.2	3.3	3.6	4.85	4.6	4.25	4.2	4.05	
15			3.2	3.15	3.3	3.7	4.6	4.5	4.3	4.15	4.05	
16			3.15	3.25	3.3	3.7	4.8	5.4	4.3	4.15	4.05	
17			3.2	3.3	3.3	3.6	4.5	4.95	4.3	4.15	4.05	
18			3.2	3.35	3.25	3.5	4.6	4.95	4.3	4.45	4.05	
19			3.2	3.4	3.3	3.5	4.4	5.5	4.2	4.35	4.1	
20			3.15	3.45	3.2	3.35	4.4	5.65	4.2	4.3	4.05	
21			3.2	3.35	3.4	3.3	4.8	5.05	4.2	4.3	4.05	
22			3.2	3.3	3.35	3.2	4.6	7.15	4.2	4.35	4.1	
23			3.2	3.35	3.65	3.1	4.5	5.1	4.15	4.3	4.15	
24			3.25	3.3	3.7	3.1	6.5	4.9	4.1	4.3	4.2	
25			3.15	3.3	3.75	3.15	4.8	4.8	4.1	4.25	4.2	
26			3.1	3.5	3.5	3.4	4.65	4.75	4.3	4.3	4.2	
27			3.1	3.5	3.45	3.3	4.6	5.7	4.35	4.2	4.2	
28			3.05	3.45	3.45	3.3	4.55	4.7	4.35	4.2	4.2	
29			3.05	3.5	3.2	3.3	4.5	4.6	4.3	4.2	4.2	
30			3.05	3.4	3.15	3.3	6.3	4.6	4.3	4.1	4.0	
31			3.0		3.1		6.2	4.5		4.1		

Daily discharge, in second-feet, of Purgatory River near Trinidad, Colo., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	13	13	13	.....	.....	.....	.....	.....	.....	.....	35	46
2	30	14	11	.....	.....	.....	.....	.....	.....	.....	42	39
3	35	13	13	.....	.....	.....	.....	.....	.....	.....	42	46
4	22	13	14	.....	.....	.....	.....	.....	.....	.....	31	42
5	25	15	13	.....	.....	.....	.....	.....	.....	.....	28	42
6	22	14	14	.....	.....	.....	.....	.....	.....	.....	28	62
7	22	14	13	.....	.....	.....	.....	.....	.....	.....	28	58
8	12	13	13	.....	.....	.....	.....	.....	.....	.....	28	52
9	15	13	13	.....	.....	.....	.....	.....	.....	.....	28	28
10	12	13	13	.....	.....	.....	.....	.....	.....	.....	28	39
11	15	13	.....	.....	.....	.....	.....	.....	.....	.....	52	39
12	12	13	.....	.....	.....	.....	.....	.....	.....	.....	42	52
13	22	13	.....	.....	.....	.....	.....	.....	.....	.....	26	35
14	13	13	.....	.....	.....	.....	.....	.....	.....	35	46	28
15	22	13	.....	.....	.....	.....	.....	.....	.....	35	46	28
16	17	13	.....	.....	.....	.....	.....	.....	.....	35	62	14
17	18	12	.....	.....	.....	.....	.....	.....	.....	31	62	42
18	20	12	.....	.....	.....	.....	.....	.....	.....	35	46	42
19	18	12	.....	.....	.....	.....	.....	.....	.....	35	42	28
20	25	10	.....	.....	.....	.....	.....	.....	.....	35	31	39
21	20	10	.....	.....	.....	.....	.....	.....	.....	35	42	42
22	18	11	.....	.....	.....	.....	.....	.....	.....	35	39	52
23	18	11	.....	.....	.....	.....	.....	.....	.....	19	26	42
24	18	12	.....	.....	.....	.....	.....	.....	.....	19	52	42
25	18	11	.....	.....	.....	.....	.....	.....	.....	315	39	62
26	9	13	.....	.....	.....	.....	.....	.....	.....	76	39	90
27	18	13	.....	.....	.....	.....	.....	.....	.....	39	39	35
28	9	13	.....	.....	.....	.....	.....	.....	.....	39	39	76
29	27	.....	.....	.....	.....	.....	.....	.....	.....	39	35	76
30	17	.....	.....	.....	.....	.....	.....	.....	.....	35	35	42
31	13	.....	.....	.....	.....	.....	.....	.....	.....	42	.....	42
1908.												
1	.....	.....	.....	8	45	13	30	500	110	22	13	.....
2	.....	.....	.....	8	45	23	40	280	110	22	13	.....
3	.....	.....	.....	8	45	23	94	255	110	17	7	.....
4	.....	.....	.....	8	75	31	80	184	110	17	4	.....
5	.....	.....	.....	8	87	37	40	164	96	22	4	.....
6	.....	.....	.....	8	87	45	38	144	84	22	4	.....
7	.....	.....	.....	6	75	42	8	144	84	22	4	.....
8	.....	.....	.....	5	45	42	6	164	50	22	4	.....
9	.....	.....	.....	4	45	42	5	126	50	22	4	.....
10	.....	.....	23	37	45	50	5	126	50	22	5	.....
11	.....	.....	23	54	75	50	20	164	50	22	5	.....
12	.....	.....	23	45	64	60	350	164	50	22	13	.....
13	.....	.....	23	45	54	82	320	164	40	22	10	.....
14	.....	.....	23	23	37	95	430	164	40	22	10	.....
15	.....	.....	23	17	37	122	240	126	50	17	10	.....
16	.....	.....	17	31	37	122	340	600	50	17	10	.....
17	.....	.....	23	37	37	95	140	300	50	17	10	.....
18	.....	.....	23	45	31	70	180	300	50	63	10	.....
19	.....	.....	23	54	37	70	110	630	32	44	14	.....
20	.....	.....	17	64	23	42	110	730	32	36	11	.....
21	.....	.....	23	45	54	34	275	355	32	36	11	.....
22	.....	.....	23	37	45	20	180	2,600	32	44	14	.....
23	.....	.....	23	45	115	10	140	380	26	36	18	.....
24	.....	.....	31	37	130	10	1,500	280	20	36	24	.....
25	.....	.....	17	37	148	13	270	230	20	29	24	.....
26	.....	.....	13	75	75	45	185	208	50	36	24	.....
27	.....	.....	13	75	64	30	165	780	60	22	24	.....
28	.....	.....	10	64	64	30	144	184	60	22	24	.....
29	.....	.....	10	75	23	30	126	144	50	22	24	.....
30	.....	.....	10	54	17	30	1,350	144	50	13	8	.....
31	.....	.....	8	.....	13	.....	1,240	110	.....	13	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Purgatory River near Trinidad, Colo., for 1907 and 1908.

[Drainage area, 742 square miles.]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	35	9	18.6	1,140
February	15	10	12.6	700
March 1–10	14	11	13.0	258
October 14–31	315	19	51.7	1,850
November	62	26	38.6	2,300
December	90	14	43.7	2,690
The period				8,940
1908.				
March 10–31	31	8	19.2	838
April	75	4	35.3	2,100
May	148	13	57.2	3,520
June	122	10	46.9	2,790
July	1,500	5	263	16,200
August	2,600	110	350	21,500
September	110	20	56.6	3,370
October	63	13	25.8	1,590
November	24	4	12.0	714
The period				52,600

NOTE.—Owing to the shifting nature of the stream bed at this station the above values are at best only approximate.

PURGATORY RIVER NEAR ALFALFA (CANYON ENTRANCE), COLO.

This station, which was established March 23, 1905, and abandoned September 30, 1907, was located one-eighth of a mile below the canyon entrance, 4 miles east of Alfalfa post-office, and about 25 miles east of Trinidad, in T. 32 S., R. 60 W.

The station was maintained primarily to determine the amount of water available for storage at a reservoir site in that vicinity. No important tributaries enter for several miles above and below the station. The drainage area is about 1,300 square miles. Considerable water is used for irrigation along Purgatory River both above and below this station, some 20,000 acres being irrigated. Storage is essential for the irrigation of an additional acreage, and some of the many reservoir sites will eventually be developed.

No change has been made in the gage datum since the station was established. Gage heights during the winter months are somewhat affected by ice conditions, though the winter discharge is usually small. As the bed of the stream is of shifting character it is difficult to estimate accurately the daily discharge unless very frequent measurements are made.

Discharge measurements of Purgatory River near Alfalfa, Colo., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 17	L. D. Bull	22	7.8	2.15	5.6
March 24	do	3	.55	1.75	.3
April 17	do	14	2.10	1.80	.6
April 22	do	24	14	2.60	20
May 3	do	27	35	3.17	96
May 10	do	26	26	2.55	48
May 14	do	29	36	3.40	169
July 16	do	14	9	2.40	13
July 17	do	97	215	7.15	1,040
July 21	do	28	21	2.98	40
July 27	do	46	73	4.65	320
August 3	do	75	101	5.70	530
August 11[a]	do	30	24	3.25	49
August 19[a]	do	30	38	3.80	121
August 27	do	32	44	4.05	190
September 9[a]	do	25	8.4	2.90	8.6
September 14	do	22	2.7	2.75	4.8

[a] Wading measurement.

Daily gage height, in feet, of Purgatory River near Alfalfa, Colo., for 1907.

[Leigh D. Bull, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.7	2.55	5.0	2.7	4.35	3.3
2	.....	1.7	3.15	4.3	3.65	4.4	3.25
3	.....	1.7	3.12	4.2	3.4	4.98	3.2
4	.....	1.7	2.9	4.1	2.7	5.48	3.1
5	.....	1.7	2.9	4.02	2.7	4.3	3.1
6	.....	1.7	2.75	10.0	2.6	4.1	3.0
7	.....	1.7	2.65	5.65	2.5	3.9	3.0
8	.....	1.7	2.6	5.0	3.6	4.0	2.95
9	.....	1.7	2.6	4.55	2.75	3.6	2.9
10	2.0	1.7	2.58	4.2	2.6	3.4	2.85
11	2.0	1.7	2.58	4.0	2.5	3.3	2.8
12	1.95	1.7	2.45	3.9	2.5	3.2	2.8
13	1.95	1.7	2.75	3.75	2.45	5.0	2.75
14	1.95	1.7	3.74	3.6	2.4	3.5	2.75
15	2.1	1.7	3.69	3.4	2.4	3.4	2.75
16	2.15	1.75	4.74	3.3	2.4	3.35	2.95
17	2.15	1.8	4.01	3.75	6.9	3.3	2.85
18	2.15	1.8	3.58	3.55	4.5	3.2	2.85
19	2.1	1.9	4.44	3.45	3.6	3.7	2.85
20	2.1	2.02	3.82	3.5	3.18	3.95	2.85
21	2.02	2.6	3.4	3.5	2.95	3.5	2.8
22	1.85	2.59	3.4	3.4	3.5	4.85	2.75
23	1.75	2.55	3.4	3.3	3.52	3.3	2.8
24	1.75	2.65	3.4	3.2	3.95	3.1	2.8
25	1.7	2.6	3.4	3.3	3.15	2.98	2.8
26	1.7	2.6	3.4	3.1	8.27	3.08	2.8
27	1.7	2.65	3.4	3.0	4.8	4.3	2.8
28	1.7	2.65	3.18	2.7	5.32	4.94	2.8
29	1.7	2.52	3.1	2.1	4.6	3.85	2.8
30	1.7	2.58	8.14	3.1	4.2	6.0	2.8
31	1.7	.....	7.99	.....	4.05	3.6	.....

Daily discharge, in second-feet, of Purgatory River near Alfalfa, Colo., for 1907.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	0	23	470	50	264	52
2	.....	0	92	330	202	273	46
3	.....	0	87	310	160	382	40
4	.....	0	66	290	50	485	28
5	.....	0	70	275	50	235	28
6	.....	0	57	2,900	37	191	18
7	.....	0	50	507	28	152	18
8	.....	0	50	465	190	171	14
9	.....	0	53	375	52	97	11
10	2	0	51	305	35	65	8
11	2	0	51	265	25	52	6
12	2	0	40	248	25	40	6
13	2	0	70	220	20	383	4
14	2	0	237	194	14	80	4
15	4	0	218	160	14	65	4
16	6	0	418	143	14	59	14
17	6	0.5	277	218	915	52	8
18	6	.5	198	184	325	40	8
19	4	1	362	168	147	115	8
20	4	3	242	175	80	161	8
21	3	27	163	175	38	80	6
22	1	27	163	160	117	361	4
23	0	23	163	143	123	52	6
24	0	30	163	127	191	28	6
25	0	27	163	143	63	17	6
26	0	27	163	110	1,650	27	6
27	0	30	163	94	350	235	6
28	0	30	127	50	455	370	6
29	0	22	113	5	311	142	6
30	0	25	1,560	110	230	600	6
31	0	.....	1,470	.....	209	97	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Purgatory River near Alfalfa, Colo., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 10–31	6	0	2.0	87	D.
April	30	0	9.1	542	C.
May	1,560	23	230	14,100	C.
June	2,900	5	311	18,500	D.
July	1,650	14	199	12,200	C.
August	600	17	173	10,600	B.
September	52	4	13.0	774	C.
The period	.....	.....	.....	56,800	

CIMARRON (DRY) RIVER DRAINAGE BASIN.

DESCRIPTION.

Cimarron River rises in the Raton Mountains, in Colfax County, N. Mex., at an elevation of nearly 7,000 feet, and flows eastward across Beaver County, in Oklahoma, then across the southwest corner of Kansas, entering Oklahoma again in Woodward County and following a southeasterly course to its junction with Arkansas River.

This river is usually called the Dry Cimarron in New Mexico and should not be confused with the Cimarron River that rises in the Cimarron Range and is a headwater tributary of Canadian River.

The basin of the Dry Cimarron lies between the Arkansas and North River basins and is within the arid belt. East and west it measures from the source of the stream to its mouth, about 450 miles, its extreme width is not more than 50 miles, and its area is 5,200 square miles.

In the upper part of its course the Dry Cimarron is an intermittent stream, receiving little water from melting snows, flowing through a mountainous region whose precipitous, rocky slopes favor rapid run-off and being subject to disastrous floods, such as that of August 28, 1908, in the vicinity of Folsom, N. Mex. In this portion it has no important tributaries. Farther down the bottoms are sandy and porous and the soil is generally a black loam covered with buffalo grass. Considerable timber is found along all the stream courses of this basin in New Mexico and northwestern Oklahoma, but very little in Kansas.

The annual rainfall ranges from 10 to 15 inches in New Mexico and the western part of Beaver County, Okla., to 28 inches in the eastern part of Woodward County, Okla., and to 35 inches or more at the mouth of the stream.

Gaging stations have been maintained in this basin as follows:

Cimarron River near Arkalon, Kans., 1895–96, 1903–1905.
Cimarron River near Kenton, Okla., 1904–5.
Cimarron River near Garrett, Okla., 1905–1907.
Cimarron River near Waynoka, Okla., 1903–1905.

CIMARRON RIVER NEAR GARRETT, OKLA.

This station, which was established May 8, 1905, to obtain data for use in connection with the Garrett project of the United States Reclamation Service, was located at Strong's ranch, about 3 miles west of Garrett, Okla., 20 miles east of Kenton, and 50 miles by stage from Clayton, N. Mex., the nearest railroad station. The station was abandoned September 30, 1907.

The locality is below the mouth of North Carriso and South Carriso creeks and 1 mile below the site of the proposed dam for a storage reservoir. The dam site is in the SW. $\frac{1}{4}$ sec. 9, T. 5 N., R. 4 E., Cimarron meridian. The reservoir, with a dam 80 feet high, will have a capacity of 58,000 acre-feet. The project covers about 30,000 acres of land.

Very little irrigation is practiced on this stream above the station.

The drainage area at the station is about 2,100 square miles.

The datum of the gage remained constant while the station was in operation.

Daily gage height, in feet, of Cimarron River near Garrett, Okla., for 1907.

[R. L. Strong, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	0.95	0.9	0.8	0.3	0.7	0.9	3.3	1.0
2	1.0	.9	.8	.3	.7	.9	1.4	1.1
3	1.0	.9	.75	.3	.65	.9	3.3	4.2
4	1.0	.9	.7	.3	.65	.9	1.5	3.0
5	1.0	.9	.7	.35	.65	.85	1.3	4.5
6	1.0	.9	.65	.35	.65	.8	1.0	1.0
7	1.0	.9	.6	.35	.65	.75	1.0	.95
8	1.0	.9	.55	.35	.7	1.5	.95	.95
9	1.0	.9	.55	.3	.75	.85	.75	.9
10	1.0	.9	.55	.3	.75	.85	.6	.9
11	1.0	.9	.5	.3	.75	.8	2.0	.9
12	1.0	.9	.5	.3	.75	.8	.95	.....
13	1.0	.9	.5	.3	.9	.8	3.42	.....
14	1.0	.9	.4	.3	.8	.75	1.3	.....
15	1.0	.9	.4	.3	.75	.7	1.0	.....
16	1.0	.9	.35	.3	.75	.65	.7	.....
17	1.0	.9	.3	.3	.7	.65	1.8	.....
18	1.0	.9	.3	.3	.6	.6	2.75	.....
19	1.0	.9	.35	.4	.6	.55	6.2	.....
20	1.0	.9	.35	.6	.55	.55	2.0	.....
21	.95	.9	.35	.7	.55	.55	1.0	.....
22	.95	.9	.35	.7	.55	.55	1.0	.....
23	.95	.9	.3	.7	.45	.55	1.0	.....
24	.95	.9	.3	.6	.45	.5	1.0	.....
25	.95	.9	.3	.55	.45	.5	1.0	.....
26	.95	.85	.3	.5	.45	.5	1.1	.....
27	.95	.8	.3	.5	.4	.5	1.42	.....
28	.95	.75	.3	.5	.4	.5	1.9	.....
29	.9	.....	.3	.6	3.4	.5	2.0	.....
30	.9	.....	.3	.65	1.2	.5	1.8	.....
31	.9	.....	.3	.....	1.0	.....	1.75	.....

Rating table for Cimarron River near Garrett, Okla., for 1906 and 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	0.5	1.60	79	2.80	245	4.00	478
.40	2.5	1.70	90	2.90	262	4.20	524
.50	4.8	1.80	102	3.00	280	4.40	571
.60	7.5	1.90	114	3.10	298	4.60	619
.70	10.5	2.00	126	3.20	316	4.80	669
.80	14	2.10	139	3.30	334	5.00	720
.90	19	2.20	152	3.40	353	5.20	780
1.00	24	2.30	166	3.50	372	5.40	840
1.10	30	2.40	180	3.60	392	5.60	900
1.20	38	2.50	195	3.70	413	5.80	960
1.30	47	2.60	211	3.80	434	6.00	1,020
1.40	57	2.70	228	3.90	456	6.20	1,100
1.50	68						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906 and is well defined.

Monthly discharge of Cimarron River near Garrett, Okla., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	24	19	22.9	1,410	A.
February	19	12	18.5	1,030	A.
March	14	.5	4.15	255	B.
April	10.5	.5	3.30	196	B.
May	353	2.5	21.3	1,310	A.
June	68	4.8	12.4	738	A.
July	1,100	7.5	120	7,380	A.
August 1–11	595	19	143	3,120	A.
The period				15,400	

CANADIAN RIVER DRAINAGE BASIN.

DESCRIPTION.

Canadian River (frequently called Red River in New Mexico) rises in the Cimarron Mountains in Colfax County, N. Mex., flows southward across Mora and San Miguel counties, then turns and flows eastward across northern Texas and through Oklahoma, uniting with Arkansas River about 80 miles above Fort Smith, Ark. The total length of the river from Raton Pass, N. Mex., to the mouth is about 750 miles. Altitudes within the basin range from about 9,000 feet at the head to 460 feet at the mouth. Some of the highest peaks in the Cimarron Range are more than 12,000 feet in elevation.

Cimarron, Mora, and Sapello rivers, and Ute Creek, all in New Mexico, are the principal perennial tributaries, but many of the intermittent tributaries, such as the Sweetwater, carry large quantities of flood water. The total drainage of the river in New Mexico is about 13,000 square miles. The North Fork of the Cimarron (frequently called Beaver Creek at its head) is the most important of the lower tributaries. Its drainage area lies just south of the Cimarron (Dry). Along the headwaters of the Canadian in New Mexico is a considerable area of timber land and woodland, and the drainage area in eastern Oklahoma is also wooded. The remainder of the area in New Mexico, Texas, and Oklahoma consists of dry plains.

The annual precipitation varies from 20 inches or more in the mountainous sections to 12 inches or less on the plains of New Mexico and Texas; in Oklahoma the range is from 20 inches in the western part to 35 inches near the mouth of the stream. Except along the lower course the run-off is very uncertain and the river bed is frequently dry for long periods; at other times it carries very disastrous floods. The winters along this stream are mild and the stream flow is rarely affected by ice conditions, except at the higher altitudes.

Many tracts of land are irrigated along the upper Canadian and tributaries, although the aggregate area is only a few thousand acres; the number and acreage of these tracts are, however, rapidly being

increased. Good storage sites are afforded by a number of natural lakes and basins, and reservoirs will eventually be constructed on the Cimarron, Vermejo, Ute Creek, Sapello, Mora, and other tributaries, which will provide for the irrigation of hundreds of thousands of acres.

Owing to the intermittent character of the stream, opportunities for water-power development are not very good except on the upper reaches of the mountain streams, but these opportunities will be somewhat increased by storage reservoirs. It may eventually be possible to develop commercially over 25,000 horsepower in New Mexico. At present no important water-power plants are in operation.

The following list gives the gaging stations which have been maintained in the Canadian River basin:

Canadian River near Logan, N. Mex., 1904–5.
Canadian River at Calvin, Okla., 1904–1908.
Cimarron River at Ute Park, N. Mex., 1907–8.
Cimarron River at Springer, N. Mex., 1907–8.
Rayado River near Springer, N. Mex., 1907–8.
Mora River at La Cueva, N. Mex., 1903–1908.
Mora River near Weber, N. Mex., 1903–4.
Mora River near Watrous, N. Mex., 1894–1896.
Sapello River at Sapello, N. Mex., 1903–4.
Sapello River at Los Alamos, N. Mex., 1903–1908.
Manuelitos River near Sapello, N. Mex., 1903–4.
Ute Creek near Logan, N. Mex., 1904–1906.
Beaver Creek at Beaver, Okla., 1904–5.
North Fork of Canadian River near Woodward, Okla., 1903–1906.
North Fork of Canadian River near El Reno, Okla., 1902–1908.
North Fork of Canadian River near Oklahoma, Okla., 1899.
North Fork of Canadian River near Eufaula, Okla., 1899.

CANADIAN RIVER AT CALVIN, OKLA.

This station, which was established in 1904 by the United States Weather Bureau, primarily to obtain flood data, is located at the railroad bridge about one-fourth mile west of Calvin, Okla. The bridge has a total length of 835 feet, with a trestle approach of 30 feet on the left bank. Neither bank overflows beyond the limits of the bridge and trestle approach. The bed of the stream is composed of clean sand and is shifting.

Gage heights for 1907 and 1908 have been furnished by Thomas W. Purcell, the observer for the Weather Bureau.

Discharge measurements of Canadian River at Calvin, Okla., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	W. A. Laub	408	618	3.00	1,020
March 13	do	299	607	3.35	1,900
April 13	do	325	407	2.75	799

Daily gage height, in feet, of Canadian River at Calvin, Okla., for 1907 and 1908.

[Thomas Purcell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.0	2.9	3.1	2.2	4.0	4.0	4.9	2.5	3.3	2.5	3.5	3.7
2	3.1	2.8	3.5	2.3	3.2	3.7	4.5	2.5	3.2	3.3	3.5	3.5
3	3.6	2.8	3.4	2.4	3.5	3.4	4.0	2.5	2.9	3.3	3.5	3.4
4	3.7	2.7	3.2	2.3	3.0	3.4	3.7	2.9	2.8	3.3	3.5	3.3
5	3.5	3.2	3.0	2.9	2.9	3.4	3.7	2.9	2.8	7.0	3.3	3.2
6	3.3	2.8	3.0	3.8	3.0	3.2	3.7	3.1	2.9	4.0	3.2	3.1
7	3.3	2.8	3.1	3.5	4.1	3.2	3.8	4.3	2.6	3.2	3.1	3.1
8	3.2	2.7	2.9	3.3	3.7	3.4	3.9	3.9	2.5	3.0	3.0	3.0
9	3.1	2.8	2.9	2.9	3.7	3.3	3.8	3.6	2.9	3.0	3.5	3.0
10	3.2	2.7	2.9	2.6	3.5	3.3	4.3	3.9	3.5	2.8	3.3	3.0
11	3.1	2.7	2.8	2.4	3.2	5.4	4.0	3.8	3.2	2.7	3.2	2.9
12	3.0	2.7	2.8	2.9	3.3	4.4	4.1	3.8	3.4	2.6	3.1	2.9
13	3.0	3.0	2.8	2.8	3.0	4.0	3.7	3.4	3.1	2.5	3.0	3.1
14	3.2	3.0	2.7	2.5	2.9	3.8	3.5	3.2	3.5	2.5	2.9	3.2
15	3.2	2.9	2.7	2.3	2.6	4.0	3.5	3.3	3.5	2.9	2.9	3.2
16	3.1	2.9	2.6	2.2	3.0	3.8	3.4	2.9	3.1	2.8	2.8	3.1
17	3.1	2.9	2.4	2.2	2.9	3.4	3.2	2.7	3.2	2.8	2.8	3.0
18	3.7	2.9	2.8	2.1	3.0	3.1	3.0	2.5	3.0	2.7	2.8	3.1
19	3.5	3.4	3.0	2.1	3.0	2.9	2.9	2.4	3.6	2.6	2.8	3.0
20	3.5	3.7	2.8	2.1	2.7	2.9	2.8	2.4	2.7	2.6	3.3	3.0
21	3.2	3.2	2.8	2.1	2.6	3.6	3.6	2.2	2.9	2.6	3.2	3.1
22	3.2	3.0	2.8	2.0	2.5	3.2	3.5	2.1	2.7	2.5	3.2	4.2
23	2.9	3.0	2.8	2.2	2.1	5.4	3.3	2.1	2.5	2.5	3.1	3.9
24	2.8	2.9	3.0	2.2	3.0	4.8	3.2	2.3	2.3	2.4	3.1	3.8
25	3.0	3.6	3.0	2.4	3.3	4.0	3.5	2.0	2.0	2.4	3.1	3.8
26	3.2	3.4	3.3	2.2	3.7	4.5	3.3	1.9	2.0	2.6	3.1	3.9
27	3.0	3.4	3.5	2.4	4.0	4.0	3.1	5.8	1.8	2.7	3.5	3.8
28	3.0	3.2	3.6	2.3	3.5	5.4	2.9	4.8	1.7	2.7	3.6	3.8
29	3.0	.....	3.6	2.3	4.2	5.3	3.0	4.4	1.7	2.6	3.5	4.0
30	3.0	.....	3.7	2.7	4.0	5.3	2.8	3.9	1.7	3.3	3.5	3.8
31	2.9	.....	3.6	.....	4.1	.....	2.9	3.5	.....	3.6	.....	3.6
1908.												
1	3.5	3.1	3.9	3.3	4.3	4.2	4.0	3.5	4.1	4.1	4.1	6.1
2	3.4	3.0	3.8	3.3	4.3	5.6	4.0	3.1	3.8	3.9	4.2	5.0
3	3.3	3.0	3.7	3.3	4.0	7.4	4.9	3.0	3.8	3.6	3.7	4.5
4	4.0	3.0	3.7	3.2	4.1	6.4	4.7	2.9	4.0	3.4	3.5	4.2
5	4.2	3.0	3.6	3.6	4.0	7.6	4.2	3.0	3.8	3.2	3.3	4.3
6	4.3	3.0	3.5	3.6	4.2	6.5	4.0	2.8	3.7	3.0	3.2	4.1
7	4.2	3.0	3.5	3.6	3.8	4.8	3.8	2.8	4.2	3.0	3.2	3.9
8	4.0	3.0	3.5	3.7	3.5	11.4	3.5	2.7	4.3	2.9	3.0	3.8
9	3.8	3.2	3.9	4.2	3.4	7.2	4.5	2.7	3.9	3.0	3.0	3.6
10	3.7	3.2	3.8	5.9	3.8	11.8	4.1	3.1	3.7	3.1	3.0	3.8
11	3.6	3.2	3.6	5.6	3.7	9.2	3.6	3.1	3.5	2.9	2.9	3.6
12	3.5	4.2	3.5	5.1	3.5	7.3	3.4	2.8	3.3	3.7	2.9	3.4
13	3.5	3.8	3.5	4.6	4.2	6.4	3.3	2.8	3.3	3.3	2.8	3.3
14	3.5	4.5	4.0	4.6	6.1	5.5	3.2	2.9	3.5	3.3	2.8	3.2
15	3.4	4.1	3.8	4.7	4.8	5.4	3.0	3.0	3.8	3.0	2.8	3.3
16	3.3	4.0	3.6	4.5	4.7	8.0	3.0	2.9	3.2	2.9	2.8	3.4
17	(a)	3.8	3.5	4.5	4.4	8.3	2.9	2.9	3.2	2.8	2.7	3.6
18	3.2	3.7	3.5	4.6	4.2	5.6	2.9	2.8	3.1	2.7	2.8	3.5
19	3.2	3.7	3.3	4.5	3.9	5.0	3.0	4.0	3.7	2.7	2.8	3.6
20	3.0	3.7	3.2	4.7	3.8	4.5	3.0	3.8	3.7	2.8	2.8	3.6
21	3.0	4.2	3.2	4.8	3.6	3.8	3.7	3.8	3.5	4.4	2.8	3.5
22	3.2	3.9	3.1	4.8	3.7	4.1	3.3	4.1	3.4	6.5	4.6	3.5
23	3.2	3.5	3.1	5.4	7.5	4.2	3.0	4.2	3.8	8.4	4.5	3.5
24	3.1	3.4	3.1	6.0	17.2	3.7	3.1	3.7	3.4	6.3	3.9	3.5
25	3.1	4.9	3.0	5.4	9.2	3.6	3.1	3.6	3.4	7.4	4.4	3.4
26	3.0	4.6	3.0	5.5	7.3	3.9	3.0	3.9	3.5	7.1	4.5	3.4
27	3.0	4.2	3.0	5.3	6.9	3.4	3.1	3.4	3.8	6.0	4.0	3.4
28	3.0	4.1	2.9	4.9	5.9	3.9	3.5	4.4	3.5	5.4	6.1	3.4
29	2.9	4.0	3.0	4.6	5.0	3.6	3.6	4.0	3.8	4.9	8.4	3.3
30	3.0	.....	3.1	4.5	4.5	3.7	3.9	3.8	4.4	4.5	7.8	3.3
31	3.1	.....	3.2	.....	3.7	.....	3.4	3.8	.....	4.1	.....	3.2

a River frozen January 17, 1908.

CIMARRON RIVER AT UTE PARK, N. MEX.

This station, which was established July 14, 1907, to determine the amount of water available for storage and irrigation, is located at the highway bridge 300 feet north of the railway station at Ute Park, N. Mex., the terminus of the St. Louis, Rocky Mountain and Pacific Railroad. It has been maintained in cooperation with the territorial engineer of New Mexico.

The station is one-half mile below the mouth of Ute Creek and is below most of the mountain tributaries except the Rayado, which enters several miles below. The drainage area above the station is over 200 square miles.

Very little water is diverted above this point, but most of the normal flow of the stream is used for irrigation in the valley below. The Eagles Nest reservoir site, which has a capacity of over 100,000 acre-feet, is situated in the canyon a few miles upstream from this station and is capable of storing the entire run-off.

Ice is found on this stream during the winter months, but usually has very little effect on the open-channel flow. High water measurements are made at the bridge and low water measurements by wading.

The rod gage datum has remained constant since the station was established. The stream bed is fairly permanent, but it is rather rough, making high-water measurements somewhat inaccurate. Results, however, should be very good.

Discharge measurements of Cimarron River at Ute Park, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 12	V. L. Sullivan	18	10.9	0.40	13.3
1908.					
March 28	V. L. Sullivan	25	14.6	.50	22.0
April 26	R. L. Cooper	36	39.0	1.10	112
June 27	do	26	15.3	.40	17.4
August 11	do	27	15.1	.45	18.2
November 1	do	25.5	13.9	.40	14.1
December 19	J. B. Stewart	23	12.8	.40	7.1

NOTE.—Measurements made by wading at different sections.

Daily gage height, in feet, of Cimarron River at Ute Park, N. Mex., for 1907 and 1908.

[R. A. Shearer and Mrs. R. P. Woodward, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct..	Nov.	Dec.
1907.							1907.						
1	.....	0.6	0.8	0.4	0.4	0.4	16	0.5	0.5	0.4	0.4	0.5	0.3
2	.....	.6	.7	.4	.4	.4	17	.5	.4	.4	.4	.4	.3
3	.....	.7	.7	.4	.4	.3	18	.5	.5	.4	.4	.4	.3
4	.....	.7	.6	.4	.4	.3	19	.5	.4	.4	.4	.4	.3
5	.....	.6	.5	.4	.4	.3	20	.5	.6	.4	.4	.4	.3
6	.....	.5	.5	.4	.4	.4	21	.5	.5	.4	.4	.5	.3
7	.....	.5	.5	.6	.4	.4	22	.6	.5	.4	.4	.45	.4
8	.....	.5	.5	.6	.4	.4	23	.6	.5	.4	.4	.4	.4
9	.....	.5	.5	.5	.4	.4	24	.5	.5	.4	.4	.4	.4
10	.....	.5	.5	.5	.4	.4	25	.5	.....	.4	.4	.3	.4
11	.....	.5	.5	.4	.4	.4	26	.5	.....	.4	.4	.5	.4
12	.....	.6	.5	.4	.4	.4	27	.5	.....	.4	.4	.4	.4
13	.....	.6	.5	.4	.6	.4	28	.7	.....	.4	.4	.4	.4
14	0.5	.7	.5	.4	.6	.3	29	.6	.....	.4	.4	.4	.4
15	.5	.6	.5	.4	.5	.3	30	.5	.....	.4	.4	.3	.4
							31	.6	.....	.....	.4	.....	.4

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	0.4	0.5	0.4	0.5	1.0	0.9	0.4	0.5	0.3	0.3	0.5	0.3
2	.4	.5	.4	.5	1.0	.7	.4	.5	.3	.3	.5	.4
3	.4	.5	.4	.5	1.1	.7	.4	.5	.3	.2	.4	.4
4	.5	.5	.4	.5	1.1	.7	.4	.4	.4	.2	.4	.4
5	.4	.5	.4	.5	1.1	.7	.4	.4	.4	.2	.4	.4
6	.4	.5	.4	.5	1.1	.7	.4	.4	.3	.2	.4	.5
7	.4	.4	.4	.5	1.0	.7	.4	.5	.3	.2	.4	.5
8	.4	.4	.4	.5	.9	.7	.5	.5	.3	.2	.4	.5
9	.4	.4	.4	.5	.9	.7	.5	.5	.3	.2	.4	.4
10	.4	.4	.4	.6	.9	.7	.4	.5	.3	.2	.4	.4
11	.4	.4	.4	.4	1.0	.7	.4	.4	.2	.2	.4	.4
12	.4	.4	.4	.8	1.0	.7	.4	.4	.2	.2	.4	.4
13	.4	.4	.4	.95	1.0	.7	.4	.4	.2	.2	.4	.3
14	.4	.4	.4	1.00	1.0	.6	.4	.5	.2	.2	.4	.3
15	.4	.4	.6	1.40	.9	.6	.4	.5	.3	.2	.4	.4
16	.4	.5	.6	1.45	.9	.6	.5	.4	.3	.2	.3	.4
17	.4	.5	.6	1.4	1.0	.5	.5	.4	.3	.2	.2	.5
18	.4	.4	.6	1.4	1.0	.5	.5	.4	.3	.2	.2	.5
19	.4	.4	.6	1.3	1.0	.5	.5	.4	.3	.2	.2	.5
20	.4	.4	.6	1.3	1.0	.4	.5	.5	.3	.2	.2	.4
21	.4	.4	.6	1.3	1.0	.4	.5	.5	.3	.2	.3	.4
22	.4	.4	.6	1.2	.9	.3	.4	.5	.2	.2	.3	.4
23	.4	.4	.6	1.3	.9	.3	.4	.4	.2	.2	.3	.4
24	.4	.3	.6	1.3	.9	.3	.4	.4	.3	.2	.3	.4
25	.4	.3	.6	1.3	1.0	.3	.3	.5	.3	.2	.3	.4
26	.4	.3	.6	1.1	.9	.4	.4	.5	.3	.2	.3	.4
27	.4	.3	.6	1.1	.9	.4	.4	.5	.3	.3	.3	.5
28	.4	.3	.5	1.1	.9	.4	.4	.5	.3	.3	.3	.5
29	.4	.3	.6	1.0	1.0	.4	.4	.5	.3	.4	.3	.5
30	.5	.....	.6	1.0	1.0	.4	.5	.4	.3	.4	.3	.4
31	.5	.....	.5	.....	.9	.....	.5	.4	.....	.4	.....	.4

Rating tables for Cimarron River at Ute Park, N. Mex.

JULY 14, 1907, TO NOVEMBER 2, 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	6	0.90	78
.30	9	1.00	95
.40	14	1.10	112
.50	22	1.20	129
.60	33.5	1.30	146
.70	47	1.40	163
.80	62		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions It is based on seven discharge measurements made during 1907 and 1908 and is not well defined.

NOVEMBER 3 TO DECEMBER 31, 1908.

[The indirect method for shifting channels used.]

Daily discharge, in second-feet, of Cimarron River at Ute Park, N. Mex., November 3 to December 31, 1908.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		6.5	11	13.0	8.5	21	7.5	7.0
2		10.0	12	12.5	8.0	22	7.5	7.5
3	13.5	9.5	13	12.5	6.0	23	7.5	7.5
4	13.5	9.5	14	12.5	6.0	24	7.5	8.0
5	13.5	9.5	15	12.0	8.0	25	7.5	8.0
6	13.5	14.0	16	8.0	8.0	26	7.5	8.0
7	13.0	14.0	17	5.5	10.5	27	7.0	13.0
8	13.0	13.5	18	5.5	10.5	28	7.0	13.5
9	13.0	9.0	19	5.0	10.5	29	7.0	14.0
10	13.0	9.0	20	5.0	7.0	30	6.5	9.0
						31		9.0

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Cimarron River at Ute Park, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
July 14–31	47	22	25.9	925
August	57	14	31.0	1,910
September	62	14	21.4	1,270
October	33.5	14	15.8	972
November	33.5	9	16.2	964
December	14	9	12.2	750
The period				6,790
1908.				
January	22	14	14.8	910
February	22	9	15.2	874
March	33.5	14	24.0	1,480
April	172	22	89.4	5,320
May	112	78	90.6	5,570
June	78	9	31.4	1,870
July	22	9	16.4	1,010
August	22	14	18.4	1,130
September	14	6	8.73	519
October	14	6	7.16	440
November	22	5	10.5	625
December	14	6	9.43	580
The year	172	5	28.0	20,300

NOTE.—Owing to the shifting nature of the stream bed at this station the above values of mean monthly discharge are at best only approximate. Values of accuracy vary from fair (C) to approximate (D).

CIMARRON RIVER AT SPRINGER, N. MEX.

This station, which was established July 13, 1907, primarily to determine the amount of unused water in the valley above, is located at Springer, N. Mex., at the highway bridge which crosses the river about one-half mile above the Atchison, Topeka and Santa Fe Railway bridge, about 6 miles below the mouth of the Rayado and 6 miles above its junction with the upper Canadian. The channel is practically without flow during the irrigation season. The drainage area is nearly 1,000 square miles.

The station has been maintained in cooperation with the territorial engineer of New Mexico.

The datum of the rod gage has not been changed. High-water discharge measurements are made from the bridge. The flow is little affected by ice. On account of the shifting character of the stream and the comparatively small number of discharge measurements the results at this station have not been entirely satisfactory.

Discharge measurements of Cimarron River at Springer, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 13	V. L. Sullivan	67	22.9	.....	27.5
October 13	do	20	8.10	0.00	3.3
1908.					
March 28	V. L. Sullivan	54	19.4	.60	18.9
April 21	R. L. Cooper	56	64.0	1.10	203
July 12	do	18.5	5.4	.00	1.7
August 12	do	23	8.0	.05	2.0
November 2	do	32.5	14.9	.30	17.3
December 20[a]	J. B. Stewart	25	15.9	.48	5.6

[a] Made by wading.

Daily gage height, in feet, of Cimarron River at Springer, N. Mex., for 1907 and 1908.

[W. L. Sever, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]						1907.					
1	.....	0.65	0.0	0.0	0.0	16	−0.3	0.1	0.0	0.1	0.0
2	.....	.6	.0	.0	.0	17	− .4	.0	.0	.0	.....
3	.....	.65	.0	.0	.0	18	.1	.0	.0	.0	.....
4	.....	.6	.0	.0	.0	19	.1	.0	.0	.2	.....
5	.....	.6	.0	.0	.0	20	.1	.0	.0	.1	.....
6	.....	.5	.0	.0	.0	21	.48	.0	.0	.0	.....
7	.....	.4	.0	.0	.0	22	.4	.0	.0	.0	.....
8	.....	.4	.0	.0	.0	23	.4	.0	.0	.0	.....
9	.....	.3	.0	.0	.0	24	.2	.0	.0	.0	.....
10	.....	.3	.0	.0	.0	25	.2	.1	.1	.0	.....
11	.....	.3	.0	.0	.0	26	.2	.1	.0	.0	.....
12	−0.1	.3	.0	.1	.0	27	.6	.1	.0	.0	.....
13	− .2	.2	.0	.1	.0	28	.85	.1	.0	.0	.....
14	− .2	.1	.0	.1	.0	29	.72	.0	.0	.0	.....
15	− .3	.1	.0	.1	.0	30	.6	.0	.0	.0	.....
						31	.75	.....	.0	.....	.....

[a] Ice conditions December 17–28, 1907.

Daily gage height, in feet, of Cimarron River at Springer, N. Mex., for 1907 and 1908— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	0.5	0.7	0.6	0.6	1.0	0.5	0.0	0.0	0.0	−0.2	0.3	0.3
2	.4	.4	.6	.5	1.0	.5	.0	.0	.0	− .2	.3	.3
3	.3	.7	.6	.4	1.1	.3	.0	.0	.1	− .2	.3	.4
4	.2	.6	.6	.4	1.1	.2	.0	.0	.0	− .2	.3	.4
5	.2	.6	.6	.3	1.1	.2	− .1	.0	.0	− .2	.3	.4
6	.5	.4	.7	.3	1.1	.2	− .1	.0	.0	− .2	.3	.4
7	.6	.5	.7	.3	1.0	.0	− .1	.1	.0	− .2	.3	.4
8	.5	.6	.7	.3	1.0	.0	.0	.1	.0	− .2	.2	.4
9	.4	.5	.8	.3	.9	.0	.0	.0	− .1	− .2	.2	.4
10	.5	.4	.6	.3	.9	.0	.0	.0	− .1	− .2	.2	.4
11	.5	.5	.6	.3	.9	.0	.0	.1	− .1	− .2	.2	.4
12	.5	.5	.6	.4	.9	.1	.0	.1	− .1	− .2	.3	.4
13	.5	.5	.6	.6	.9	.1	.0	.0	− .1	− .2	.3	.5
14	.6	.7	.6	.8	.9	.1	.0	1.15	− .1	− .2	.3	.4
15	.7	.7	.6	1.0	.9	.1	2.5	.5	− .1	− .2	.3	.3
16	.6	.8	.6	1.0	.9	.1	1.0	.3	− .1	− .2	.3	.3
17	.8	.9	.6	1.15	.9	.1	.0	.0	− .1	− .2	.2	.2
18	.8	.9	.7	1.2	.9	.1	.0	.0	− .1	− .2	.2	.3
19	.7	.7	.7	1.1	.8	.0	.0	.0	− .1	− .2	.2	.5
20	.7	.7	.7	1.1	.7	.0	.0	.3	− .1	− .2	.2	.5
21	.8	.8	.8	1.15	.7	.0	.0	.5	− .1	− .2	.2	.5
22	.6	.7	.7	1.1	.7	.0	.0	.45	− .2	.1	.2	.5
23	.6	.6	.7	1.15	1.0	.0	.0	.4	− .2	.2	.1	.4
24	.6	.6	.6	1.15	1.0	.0	.0	.4	− .2	.2	.1	.4
25	.5	.6	.6	1.2	.9	.0	.2	.3	− .2	.2	.1	.4
26	.5	.6	.6	1.1	.9	.35	.0	.3	− .2	.2	.1	.8
27	.5	.6	.6	1.1	.9	.2	.0	.2	− .2	.2	.1	.6
28	.5	.5	.6	1.0	.8	.1	.0	.1	− .2	.2	.5	.5
29	.5	.6	.6	1.0	.7	.0	.0	.1	− .2	.3	.3	.4
30	.5	.....	.7	1.0	.6	.0	.65	.1	− .2	.3	.3	.4
31	.5	.....	.6	.....	.6	.....	.3	.0	.....	.3	.....	.5

RAYADO RIVER NEAR SPRINGER, N. MEX.

This station, which was established July 9, 1907, to obtain data concerning the amount of water available for storage and irrigation, is located at the proposed site of the Farmers Development Company's reservoir dam, and about one-half mile north of their office, which is at Miami ranch, 12 miles west of Springer, the nearest railroad point. The records have been obtained in cooperation with the territorial engineer of New Mexico.

The station is about 6 miles above the junction of the Rayado with Cimarron River, and below the important tributaries. The drainage area is about 100 square miles. Considerable water is diverted for irrigation above this point.

The rod gage datum has remained permanent since the station was established. Discharge measurements have been taken by wading. Ice conditions have practically no effect on the flow. The stream bed is fairly permanent, and good results will be obtained when the discharge has been well defined by measurements.

Discharge measurements of Rayado River near Springer, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 9	V. L. Sullivan	3.5	0.64	0.10	0.36
October 11	do	10	2.80	.20	1.80
1908.					
March 27	V. L. Sullivan	2.2	.40	.10	.40
April 24	R. L. Cooper	15	7.80	.55	21.0
June 19[a]	do	10	2.60	.15	.80
August 10	do			.00	[b].50
October 31	do			.10	[b].50
December 19	J. B. Stewart			.10	[b].30

[a] Wading measurement. [b] Discharge estimated.

Daily gage height, in feet, of Rayado River near Springer, N. Mex., for 1907 and 1908.

[J. W. Ausherman, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1		0.2	0.35	0.15	0.1	0.1	16	0.0	0.1	0.2	0.2	0.1	
2		.25	.5	.15	.1	.1	17	.1	.1	.2	.2	.1	
3		.3	.48	.15	.1	.1	18	.0	.1	.2	.2	.1	
4		.45	.35	.15	.1	.1	19	.0	.15	.2	.2	.1	
5		.35	.3	.15	.1	.1	20	.0	.15	.2	.2	.1	
6		.3	.3	.15	.1	.1	21	.0	.15	.2	.2	.1	
7		.3	.3	.15	.1	.1	22	.0	.15	.2	.1	.1	0.1
8		.2	.3	.15	.1	.1	23	.0	.15	.2	.1	.1	.1
9		.2	.3	.15	.1	.1	24	.0	.15	.15	.1	.1	.1
10		.2	.25	.15	.1	.1	25	.1	.15	.15	.1	.1	.1
11		.1	.2	.15	.1	.1	26	.1	.15	.15	.1	.1	.1
12	0.1	.1	.2	.15	.1	.1	27	.1	.15	.15	.1	.1	.1
13	.1	.1	.2	.2	.1	.1	28	.1	.2	.15	.1	.1	.1
14	.1	.1	.2	.2	.1	.1	29	.1	.2	.15	.1	.1	.1
15	.1	.1	.2	.2	.1	.1	30	.1	.5	.15	.1	.1	.1
							31	.1	.35		.1		.1

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	0.1	0.1	0.1	0.2	0.3		0.1	[a]0.1	0.0	0.0	0.1	
2	.1	.1	.1	.18	.3	0.3	.1	.2	.0	.0	.1	0.1
3	.1	.1	.1	.18	.3	.2	.1	.1	.0	.0	.1	
4	.1	.1	.1	.18		.25		.1		.0	.1	.1
5	.1	.1	.1	.18		.2	.1	.1	.0	.0		.1
6	.1	.1	.1	.15	.3	.2	.1	.1	.0	.0		.1
7	.1	.1	.1	.2	.4	.3	.1	.1	.0	.0	.1	.1
8	.1	.1	.1	.3	.4	.3	.1		.0	.0	.1	.1
9	.1	.1	.1		.4	.2	.1	.0	.0	.0	.1	.1
10	.1	.1	.1	.25	.3	.2	.1	.0			.1	.1
11	.1	.1	.1	.25	.3	.2	.1		.0	.0	.1	.1
12	.1	.1	.1	.4			.1	.0	.0	.0		.1
13	.1	.1	.1	.45	.4	.2	.1	.0	.0	.0	.1	.1
14	.1	.1	.1	.6	.25	.2	.1	.0	.0	.0	.1	
15	.1	.15	.1	.4	.3	.2	.1	[b].1	.0	.0	.1	.1
16	.1	.1		.4	.3	.2	.1	.0	.1	.0	.1	.1
17	.1	.1	.1			.18	.1	.0	.1	.0	.1	
18	.1	.15		.45	.25	.18	.1	.0	.1			.1
19	.1	.15	.1		.2	.18		.0		[c].1		.1
20	.1	.2	.1	.42	.2	.12	.1	.0	.0	.0		.1
21	.1	.1	.1	.48		.15	.1		.0		.1	.1
22	.1	.1	.1	.45	.35	.18	.1	.0	.0	.0	.1	.1
23	.1	.1	.25	.52	.42	.18	.1	.1	.0	.1	.1	.1
24	.1	.1	.2	.52	.15	.18	.1	.1	.0	.1	.1	.1
25	.1	.1	.1	.58	.35	.18	.1	.0	.0	.1	.1	.1
26	.1	.1	.1	.4	.3	.5		.0	.0	.1		.1
27	.1	.1	.1	.4	.3	.1	.1	.1	.0	.1	.1	.1
28	.1	.1		.38	.3	.1	.1	.1	.0	.1	.1	.1
29	.1	.1	.3	.3	.3	.5	.1		.0			.1
30	.1		.2	.3	.25	.1	.1	.0	.0	.1		.1
31	.1		.25		.2		.2	.0		.1		.1

[a] Flood August 1, 1908; crest height, 1.2 feet.
[b] Flood August 15, 1908; crest height, 1.0 foot.
[c] Small flood October 19, 1908.

NOTE.—River frozen December 15–21, 1907; effect on discharge unknown and no correction made therefor.

It is probable that ice conditions prevailed to a greater or less extent during the winter period of 1908. No corrections made.

Rating table for Rayado River near Springer, N. Mex., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	0.2	0.20	1.8	0.40	11	0.60	25
.10	.4	.30	5.8	.50	17	.....	.....

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 12 discharge measurements made during 1907–1909 and is well defined.

Monthly discharge of Rayado River near Springer, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
July 12-31	0.4	0.2	0.33	13.1
August	17.0	.4	2.91	179
September	17.0	.8	3.73	222
October	1.8	.4	.96	59.0
November	.4	.4	.40	23.8
December	.4	.4	.40	24.6
The period	.....	.....	.....	522
1908.				
January	.4	.4	.40	24.6
February	1.8	.4	.49	28.2
March	5.8	.4	.93	57.2
April	25.0	.8	9.54	568
May	12.0	.8	6.07	373
June	17.0	.4	3.03	180
July	1.8	.4	.45	27.7
August	1.8	.2	.34	20.9
September	.4	.2	.22	13.1
October	.4	.2	.26	16.0
November	.4	.4	.40	23.8
December	.4	.4	.40	24.6
The year	25.0	.2	1.88	1,360

NOTE.—During April, May, and June, 1908, a large part of the flow was diverted into a storage reservoir above the station. The low-water discharge during the latter part of 1907 and 1908 represents only the seepage from the diversions above the station. Owing to the flashy nature of the stream it is impossible to make accurate estimates of discharge for the sudden floods which periodically occur at this station. No accuracy notes are of value; except for the stages above 0.2 foot the computed discharge is only of relative value.

MORA RIVER AND LA CUEVA CANAL AT LA CUEVA, N. MEX.

This station, which was established August 25, 1903, primarily to determine the amount of water available for storage, is located at the wagon bridge at La Cueva, N. Mex., in the Mora land grant, 26 miles north of Las Vegas, N. Mex. Since July, 1907, the records have been obtained in cooperation with the territorial engineer of New Mexico.

The station is a few miles above the mouth of the Cebolla and a short distance downstream from the intake of La Cueva canal, just below the canal wasteway. This canal carries water for irrigation and during the nonirrigating season it is used as a feeder for a reservoir below.

The canal gage is located at a footbridge below the wasteway, just north of the gaging station on the river. The datum of the canal gage has remained constant and gage readings have been taken continuously since the station was established whenever there was any water in the canal. Apparent discrepancies in the gagings of the canal are accounted for by the fact that the bed of the canal occasionally contains a considerable deposit of silt, which is cleaned out at intervals.

A little water is diverted above the station for irrigation in addition to that taken out by La Cueva canal, and considerable land is irrigated below the station. By developing the available storage at reservoir sites in that locality it will be possible to utilize the entire flow of the stream for irrigation.

The original gage was washed out in the flood of September 29, 1904, and was replaced by another at practically the same section on April 29, 1905. The datum of this staff gage, which is still in use, is 1.32 feet above that of the original gage.

Fair measurements can be made by wading at low stages; high-water measurements must be corrected for the skew of the bridge. The channel is subject to some shifting, but fair results should be obtained by making frequent measurements at the higher stages.

Discharge measurements of Mora River at La Cueva, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 10	W. A. Lamb	24	30	1.33	80
May 11	do	24	31	1.33	82
May 27	do	20	28	1.36	71
August 28	V. L. Sullivan	29	27	1.20	53
October 10	do	19	11.3	.80	16
1908.					
March 26	V. L. Sullivan	4.4	1.3	.35	.9
April 29	R. L. Cooper	19	15	.80	18
July 13	do	12	2.0	.50	1.9
August 14	do	23	24	1.10	52
October 29	do	20	13	.70	15.9
December 16[a]	J. B. Stewart	17.5	11.6	.62	11.6

[a] Wading measurement.

Daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1907 and 1908.

[Hugh London, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.8	0.8	0.9	0.9	1.3	1.65	1.0	1.0	1.7	0.6	0.8	0.7
2	.8	.85	.8	.8	1.35	1.65	.9	1.1	1.5	.6	.8	.7
3	.9	.9	.9	.8	1.35	1.8	.9	1.4	1.4	.65	.8	.55
4	1.0	.8	.9	.8	1.35	1.7	1.1	1.25	1.35	.6	.8	.6
5	.9	.9	.9	.8	1.35	1.7	1.0	1.1	1.3	.6	.8	.6
6	.8	.9	.9	.8	1.35	1.85	.9	1.0	1.2	.8	.75	.....
7	.8	.9	.9	.9	1.35	1.85	.9	.9	1.2	.5	.8	.7
8	.8	.85	.9	.8	1.3	1.7	.85	.85	1.15	.65	.75	.65
9	.9	.8	.9	.75	1.4	1.8	.75	.8	1.1	.8	.8	.7
10	.9	.9	.85	.5	1.4	1.7	.7	.7	1.0	.8	.8	.7
11	.8	.8	.9	.65	1.3	1.7	.7	.7	1.0	.8	.8	.65
12	.8	.8	.9	.75	1.3	1.75	1.1	.9	.95	.8	.8	.6
13	.9	.9	.8	.85	1.3	1.5	.85	.8	.9	.8	.8	.6
14	.8	.8	.8	1.0	1.35	1.55	.9	.8	.9	.7	.55	.75
15	.9	.8	.7	.9	1.3	1.5	.7	.7	.9	.7	.65	1.0
16	.9	.8	.8	.9	1.3	1.6	.65	.7	.9	.8	.75	.8
17	.85	.9	.9	.9	1.25	2.1	.65	.7	.9	.8	.8	.8
18	.9	.9	.9	.8	1.2	1.9	.7	2.2	.9	.8	.7	.8
19	.9	.9	.9	1.0	1.3	2.6	.6	1.0	.8	.7	.75	.8
20	.8	.85	1.0	1.1	1.3	2.3	.65	1.4	.9	.8	.75	.8
21	.8	.85	1.0	.9	1.35	2.1	.65	1.4	.8	.8	.7	.8
22	.75	.9	1.1	1.3	1.4	1.9	.75	1.25	.8	.8	.75	.....
23	.8	.9	1.1	1.3	1.45	1.8	.7	1.15	.75	.8	.8	.....
24	.75	.9	1.15	1.3	1.45	1.6	1.0	1.15	.7	.85	.8	.....
25	.75	.85	1.0	1.25	1.4	1.5	.85	1.15	.7	.8	.65	.....
26	.8	.9	1.0	1.25	1.4	1.4	.8	1.25	.6	.8	.55	.....
27	1.0	.9	1.0	1.2	1.35	1.35	1.0	1.1	.6	.8	.75	.....
28	.75	.85	1.0	1.2	1.3	1.3	1.05	1.2	.65	.8	.7	.....
29	.85	.....	.8	1.3	1.3	1.2	1.1	1.25	.65	.8	.....	.....
30	.9	.....	1.0	1.3	1.5	1.2	1.0	2.2	.55	.8	.4	.....
31	.9	.....	.95	.....	1.6	.....	1.0	1.8	.....	.8	.....	.....
1908.												
1	.....	.....	.55	.3	.8	1.0	.4	.9	.7	.5	.7	.7
2	.....	.....	.6	.3	.75	1.1	.4	1.5	.7	.55	.7	.7
3	.....	.....	.5	.3	.75	.95	.5	1.3	.8	.5	.7	.7
4	.....	.....	.5	.3	.7	.9	.4	1.2	.7	.5	.7	.7
5	.....	.....	.5	.3	.8	.9	.5	1.1	.7	.55	.7	.7
6	.....	.....	.6	.35	.75	.9	.4	1.0	.6	.5	.7	.6
7	.....	.....	.5	.35	.65	1.2	.45	.95	.4	.5	.7	.55
8	.....	.....	.6	.35	.55	.8	.45	1.1	.6	.45	.7	.6
9	.....	.....	.5	.4	.5	.8	.4	1.05	.6	.5	.7	.6
10	.....	.....	.6	.5	.5	.9	.4	.95	.5	.45	.....	.65
11	.....	.....	.5	.4	.6	1.15	.35	.9	.45	.5	.7	.7
12	.....	.8	.4	.5	.4	.95	.35	.8	.45	.55	.4	.7
13	.....	.7	.45	.45	.45	1.0	.35	.8	.4	.65	.4	.65
14	.....	.....	.5	.5	.5	1.15	.35	1.1	.55	.7	.5	.7
15	.....	.7	.45	.4	.45	1.0	.45	1.2	.4	.7	.6	.5
16	.....	.7	.5	.4	.4	.9	.5	1.1	.6	.7	.4	.55
17	.....	.5	.4	.45	.8	.8	.7	1.1	.65	.7	.55	.6
18	.....	.6	.5	.65	.55	.7	.6	.95	.65	.7	.5	.5
19	.....	.75	.6	.8	.7	.55	.65	1.1	.6	.7	.3	.75
20	.....	.7	.5	.8	.7	.5	.5	1.3	.6	.7	.5	.7
21	.....	.6	.5	.8	.7	.6	.5	1.15	.5	.7	.5	.7
22	.....	.6	.55	.8	.9	.5	.45	1.15	.45	.7	.3	.....
23	.....	.7	.5	.9	1.1	.2	.45	1.15	.45	.7	.5	.....
24	.....	.7	.45	.9	1.3	.4	.4	1.1	.3	.7	.4	.....
25	.....	.6	.5	.85	1.1	.5	.9	1.0	.5	.7	.5	.....
26	.....	.5	.4	.85	1.05	.7	.9	1.1	.45	.7	.6	.....
27	.....	.6	.35	.8	1.1	.6	.85	1.0	.55	.7	.35	.....
28	.....	.6	.3	.75	1.05	.4	.8	1.0	.4	.7	.3	.....
29	.....	.6	.35	.8	.9	.45	.7	.95	.55	.7	.3	.....
30	.....	.....	.35	.75	.95	.45	.8	.9	.4	.7	.7	.....
31	.....	.....	.3	.....	1.1	.....	.9	.8	.....	.7	.....	.....

NOTE.—Ice conditions December 1907 and 1908 and February 14, 1908.

Daily discharge, in second-feet, of Mora River at La Cueva, N. Mex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	17	20	29	32	73	102	36	35	104	6	17	11
2	17	24	22	24	80	102	28	44	82	6	17	11
3	24	27	29	24	80	120	28	74	71	8	17	4
4	32	20	29	24	80	108	45	58	66	6	17	6
5	25	28	29	24	80	108	36	44	61	6	17	6
6	18	28	29	24	80	126	28	35	51	17	14	8.5
7	18	28	29	34	80	126	28	27	51	3	17	11
8	18	24	29	26	75	108	24	23	46	8	14	8
9	25	21	29	23	87	120	17	20	41	17	17	11
10	25	28	25	8	87	108	14	13	33	17	17	11
11	18	21	29	16	81	108	14	13	33	17	17	8
12	18	21	29	23	79	114	45	27	29	17	17	6
13	26	28	23	31	77	86	24	20	26	17	17	6
14	18	21	23	43	81	91	28	20	26	11	4	14
15	26	21	17	35	75	86	14	13	26	17	8	32
16	26	21	24	35	74	96	11	13	26	17	14	17
17	23	29	31	35	66	155	11	13	26	17	17	17
18	26	29	31	27	62	131	14	167	26	17	11	17
19	26	29	31	44	72	214	8	34	18	11	14	17
20	19	25	40	53	72	177	11	74	25	17	14	17
21	19	25	40	35	74	153	11	74	18	17	11	17
22	16	29	49	73	79	131	17	58	18	17	14	.....
23	19	29	49	73	85	120	14	49	15	20	17	.....
24	16	29	54	73	85	96	35	49	12	17	17	.....
25	16	25	40	68	83	86	24	49	12	17	8	.....
26	19	29	40	68	81	74	20	58	6	17	4	.....
27	35	29	40	63	70	69	35	43	6	17	14	.....
28	16	25	40	63	64	64	40	53	8	17	11	.....
29	24	.....	24	73	64	54	44	58	8	17	6.5	.....
30	27	.....	40	73	86	54	35	167	4	17	2	.....
31	27	.....	36	.....	96	.....	35	116	.....	17	.....	.....
1908.												
1	.....	.....	5	0.5	18	30	2	30	16	6.5	16	16
2	.....	.....	6.5	.5	15	40	2	92	16	8	16	16
3	.....	.....	3.5	.5	15	26	3	68	23	6.5	16	16
4	.....	.....	3.5	.5	12	23	2	58	16	6.5	16	16
5	.....	.....	3.5	.5	18	23	1.9	48	16	8	16	16
6	.....	.....	6.5	.9	15	23	.7	40	10	6.5	16	10
7	.....	.....	3.5	.9	10	48	1.2	36	3.5	6.5	16	8
8	.....	.....	6.5	.9	5.5	16	1.2	50	10	5	16	10
9	.....	.....	3.5	1.7	3.5	16	.7	45	10	6.5	16	10
10	.....	.....	6.5	3.5	3.5	23	.7	36	6.5	5	16	13
11	.....	.....	3.5	1.7	6.5	45	.3	31	5	6.5	16	16
12	.....	16	1.7	3.5	1.6	26	.3	25	5	8	3.5	16
13	.....	11	2.5	2.5	2.5	30	.3	25	3.5	13	3.5	13
14	.....	11	3.5	3.5	3.5	45	.3	52	8	16	6.5	16
15	.....	11	2.5	1.7	2.5	30	1.2	62	3.5	16	10	6.5
16	.....	11	3.5	1.7	1.6	21	3	52	10	16	3.5	8
17	.....	3.5	1.7	2.5	17	14	9	52	13	16	8	10
18	.....	6.5	3.5	8.5	5	9	6	36	13	16	6.5	6.5
19	.....	13	6.5	18	11	4	8	52	10	16	1.5	19
20	.....	11	3.5	18	11	3	3.5	72	10	16	6.5	16
21	.....	6.5	3.5	18	11	5	3.5	57	6.5	16	6.5	16
22	.....	6.5	5	18	25	3	2.5	57	5	16	1.5	12
23	.....	11	3.5	26	41	.2	2.5	57	5	16	6.5	12
24	.....	11	2.5	26	61	1.3	2.2	52	1.5	16	3.5	12
25	.....	6.5	3.5	22	41	3	25	41	6.5	16	6.5	12
26	.....	3.5	1.7	22	37	9	25	52	5	16	10	12
27	.....	6.5	.9	18	41	5	23	41	8	16	2.3	12
28	.....	6.5	.5	15	35	1.3	20	41	3.5	16	1.5	12
29	.....	6.5	.9	18	23	2	15	36	8	16	1.5	12
30	.....	.....	.9	15	26	2	20	31	3.5	16	16	12
31	.....	.....	.5	.....	40	.....	27	23	.....	16	.....	12

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Mora River at La Cueva, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	35	16	21.9	1,350	C.
February	29	20	25.5	1,420	C.
March	54	17	32.5	2,000	C.
April	73	8	41.6	2,480	C.
May	96	62	77.7	4,780	C.
June	214	54	110	6,550	B.
July	45	11	25	1,540	B.
August	167	13	49.7	3,060	B.
September	104	4	32.5	1,930	B.
October	20	3	14.3	879	B.
November	17	2	13.4	797	C.
December 1–21	32	4	12.2	508	D.
The period				27,300	
1908.					
February 12–29	16	3.5	8.81	315	D.
March	6.5	.5	3.36	207	D.
April	26	.5	9.00	536	D.
May	61	1.6	18.0	1,110	C.
June	48	.2	17.6	1,050	C.
July	27	.3	6.87	422	D.
August	92	23	46.8	2,880	C.
September	23	3.5	8.68	516	D.
October	16	5.0	11.8	726	C.
November	16	1.5	9.38	558	C.
December	19	6.5	12.7	781	D.
The period				9,100	

Discharge measurements of La Cueva canal at La Cueva, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	W. A. Lamb	8	7.2	0.96	8.3
May 27	do	8	8.8	1.20	13
1908.					
March 26	V. L. Sullivan	7.8	6.2	.78	7

Daily gage height, in feet, of La Cueva canal at La Cueva, N. Mex., for 1907 and 1908.

[Hugh London, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1			0.3	0.8	1.15	1.2	1.0	1.2		0.9	0.4	
2		0.5	.4	.7		1.1	1.25	1.2		1.0		0.7
3		.3	.4	1.0		1.05	1.2			.9		1.1
4		.2	.35	1.1	1.2	1.2				.9		1.0
5			.4	.9	1.2	1.15				.85	.5	.9
6			.4	1.1	1.2	1.15					.7	
7	0.4		.3	1.1	1.1	1.15				1.15		.9
8			.3	.9	1.15	1.4		.9	0.5	1.3		.9
9	.4		.4	1.1	1.2	1.2		.8	.45	.6	1.3	
10			.8	1.1	1.15	1.25		.8	1.4	.3	.9	.3
11		.4	.6	1.2	1.2	1.3		.8	1.2		.8	.9
12		.2	.6	1.1	1.25	1.5			1.1	.7		1.0
13		.2	.7	1.0	1.2	1.2		.9	1.5			1.2
14		.2	.7	1.3	1.1	1.1	1.15	.65	.9	.6		.7
15		.3	.7	1.1	1.25	1.15	1.1	1.2	1.25	.9		
16		.2	.6	1.0		1.2	1.0	.9	.95	.5		
17		.3	.6	1.2	1.05	1.05	1.0	.6	.9			
18		.2	.6	1.2	1.05	1.25	1.0		.9		1.1	
19		.2	.6	1.3	1.2	1.25	.95		1.45	.95	.8	
20			.5	1.05	1.2	.9	1.15		1.1		.6	
21	.9	.5	.6	1.0	1.1	1.0	1.25		1.3		.4	
22	.4	.2	.6	1.1	1.15	1.1	.55		1.3	.5	.4	
23	.6	.2	.6	1.0	1.2	1.2	1.1	.4	.5		.6	
24		.15	.6	1.0	1.2	1.15	1.0	.6	1.0	.6		
25	.4		.8	1.25	1.2	1.15	.9		1.25	.5	.5	
26	.3	.2	.8	1.1	1.15	1.15	1.15		1.2		.9	
27		.2	.8	1.1	1.2	1.15	1.15	1.0	1.2		.5	
28	.4	.2	.8	1.2	1.1	1.15	1.2		1.2	.5		
29	.5		.7	1.2	1.3	1.15	1.1		1.4	.6		
30	.3		.8	1.2	.8	1.2	1.2		1.3		1.4	
31	.3		.8		.9		1.2					
1908.[b]												
1			1.1	.6	1.35	1.3	1.3	1.4	1.1	1.5		
2			1.0	.6	1.35	1.25	1.2	1.25	1.1	1.25		
3			1.4	.7	1.4	1.4	1.15	1.45	1.1	1.3		.1
4			1.2	.7	1.25	1.4	1.2	1.2	1.1	1.4		
5			1.4	.8	1.4	1.4	1.35	1.25	.7	1.3		
6			1.1	.6	1.4	1.4	1.3	1.3	1.1	1.6		
7			1.05	.45	1.4	1.4	1.0	1.35	1.2	1.5		
8			1.0	.5	1.25	1.3	.95	1.4	1.1	1.65		
9			1.1	.75	1.2	1.4	.7	1.4	1.0	1.4		
10			.7	.8	1.3	1.35	.8	1.3	1.5	1.5		
11			1.0	1.0	1.4	1.4	.7	1.3	1.4	1.5		
12		0.5	1.25	1.0	1.2	1.4	1.1	1.2	1.4	1.2	.7	
13			1.25	1.1	1.4	1.45	.7	1.2	1.3		.7	
14			1.2	.95	1.4	1.4	.7	1.3	.9		.9	
15		.8	1.25	.9	1.35	1.4	.9	1.4	1.4		.75	.4
16			1.1	1.1	1.4	1.3	.9	1.35	1.35		.7	.35
17		1.2	1.0	1.1		1.3	1.3	1.35	1.1		.35	.1
18		1.1	.9	.85	.95	1.4	1.1	1.3	1.4		.35	.6
19			.8	.75	1.2	1.35	1.0	.6	1.0		.65	
20		.6	1.1	1.15	1.3	1.15	1.0	.6	1.15		.4	
21		1.1	1.1	1.2	1.1	1.5	1.3	.55	1.0		.4	
22		1.1	1.15	1.3	1.1	1.3	1.3		.85		.7	.3
23		.8	1.2	1.35		1.1	1.2		1.0		.4	
24		.75	1.0	1.35	1.4	1.2	1.25		1.1		.65	
25		1.1	.75	1.25	1.35	1.3	1.4	.8	1.2		.6	
26		1.2	.7	1.2	1.4	1.5	1.5	.75	1.2		.55	
27		1.05	.6	1.3	1.4	1.5	1.2	.9	1.3		1.2	
28		.9	.6	1.4	1.2	1.4	1.3	.8	1.35		.7	
29		.9	.9	1.2	1.3	1.45	1.25	.7	1.3		.75	
30			.55	1.35	1.3	1.45	1.3	1.0	1.55		.8	
31			.6		1.3		1.4	.95				

[a] Canal was dry on days for which no gage height is given, except for July 4–13, 1907, when gage was not read.

[b] Canal was dry on dates between February 12 and December 22, 1908, for which no gage height is given, except May 23, when gage was not read. Canal also assumed dry during the winter periods January 1 to February 11 and December 23 to 31, 1908. Canal was being cleaned, October 13 to November 11, 1908.

Rating tables for La Cueva canal at La Cueva, N. Mex.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	0.2	0.50	2.3	0.90	7.4	1.30	15
.20	.5	.60	3.3	1.00	9.0	1.40	18
.30	1.0	.70	4.4	1.10	11	1.50	21
.40	1.6	.80	5.8	1.20	13		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1907. It is not well defined.

FEBRUARY TO OCTOBER, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	0.5	0.60	4.4	1.00	11	1.40	19
.20	1.0	.70	5.8	1.10	13	1.50	22
.30	1.6	.80	7.4	1.20	15	1.60	25
.40	2.4	.90	9.0	1.30	17	1.70	28
.50	3.3						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during 1908 and the form of the 1907 curve. It is not well defined.

NOVEMBER AND DECEMBER, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet,*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	1.6	0.40	4.5	0.70	8.6	1.00	14
.20	2.4	.50	5.8	.80	10	1.10	16
.30	3.3	.60	7.2	.90	12	1.20	18

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1909 and the form of preceding curves. It is not well defined. It was assumed that conditions of flow after the canal was cleaned (October to November, 1908) were essentially the same as when the two measurements in the spring of 1909 were made.

Monthly discharge of La Cueva canal at La Cueva, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	7.4	0	0.77	47
February	2.3	0	.56	31
March	5.8	1.0	3.41	210
April	15	4.4	10.7	637
May	15	0	10.8	664
June	21	7.4	12.5	744
July	14	2.8	11.3	695
August	13	0	3.21	197
September	21	0	9.60	571
October	15	0	3.49	215
November	18	0	3.10	184
December	13	0	2.63	162
The year	21	0	6.01	4,360
1908.				
January	0	0	0	0
February	15	0	4.87	280
March	19	3.8	11.3	695
April	19	2.8	11.0	655
May	19	0	16.5	1,010
June	22	13.0	18.3	1,090
July	22	5.8	13.6	836
August	20	0	12.3	756
September	24	5.8	14.6	869
October	26	0	7.81	480
November	18	0	4.98	296
December	7.2	0	.71	44
The year	26	0	9.66	7,010

NOTE.—The above results are in general only approximate. There is doubt regarding January 1 to February 11 and December 23 to 31, 1908. See gage height table footnote.

SAPELLO RIVER AT LOS ALAMOS, N. MEX.

This station, which was established August 22, 1903, to determine the amount of water available for diversion into the San Guijuella reservoir for the Las Vegas project, is located about 100 yards upstream from the post-office and general store at Los Alamos, N. Mex., 13 miles north of Las Vegas, the nearest railroad point.

The proposed reservoir lies about 6 miles northwest of Las Vegas, has a storage capacity of about 40,000 acre-feet, is to be filled from the Gallinas, Sapello, and other streams in that vicinity, and is to be used for the irrigation of 10,000 acres of land. The station is situated about 4 miles below the mouth of the Manuelitos and a few miles above the junction of the Sapello with Mora River. A considerable portion of the normal flow of the stream is diverted for irrigation above the station.

The original gage was destroyed by a flood on September 29, 1904, and was replaced in April, 1905, by the present chain gage 400 feet upstream, and at a different datum. Results for short periods during the winter season are sometimes affected by ice on this stream.

The channel is somewhat shifting in character, and on account of the inadequacy of discharge measurements, especially at the higher stages, results have not been entirely satisfactory.

Discharge measurements of Sapello River at Los Alamos, N. Mex., from 1905 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 3	R. I. Meeker	12	13	0.90	29
April 28	do	73	91	2.60	478
July 1	do	12	7.5	.40	13
August 2	do	12	11	.65	19
1906.					
March 15	J. M. Giles	12	9	.83	17
April 16	E. Patterson	32	28	1.35	60
April 17	do	54	32	1.40	60
April 27	J. M. Giles	54	33	1.40	71
May 25	E. Patterson	28	22	.60	41
July 19	J. M. Giles	27	16	.40	21
July 20	do	28	19	.55	30
August 16	do	20	8	−.05	5
September 25	W. A. Lamb	8	2.4	−.20	2.1
1907.					
March 8	W. A. Lamb	9	3.3	−.10	3.5
May 10	do	56	46	1.25	94
May 11	do	56	44	1.16	90
May 27	do	52	27	.70	41
June 8	do	52	39	1.00	69
June 25	do	20	18	.30	15
August 28	V. L. Sullivan	17	6.5	−.05	4.0
October 10	do	10	3.5	−.10	1.5
1908.					
March 26	V. L. Sullivan	10	2.8	−.10	.8
April 28	R. L. Cooper	34	17	.20	11
July 14	do	9.0	1.3	−.25	.6
August 14	do	49	50	.65	50
October 29	do	8	1.6	−.20	1.9
December 16	J. B. Stewart	10	2.8	−.20	1.2

NOTE.—Measurements were made at different sections.

Daily gage height, in feet, of Sapello River at Los Alamos, N. Mex., for 1907 and 1908.

[W. N. Frank and Wm. N. Frank, jr., observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.48	0.52	0.60	0.10	1.10	1.55	0.10	0.85	0.80	−0.10	−0.10	−0.10
2	.48	.42	.62	− .10	1.32	1.40	.15	.75	.40	− .10	− .10	− .10
3	.48	.58	.60	− .08	1.00	1.25	.18	.85	.20	− .10	− .10	− .10
4	.48	.55	.62	− .10	1.02	1.25	.10	.70	.35	− .10	− .08	− .10
5	.48	.62	.62	− .08	1.08	1.25	.10	.50	.25	− .10	− .10	− .10
6	.48	.52	.62	− .08	1.05	1.15	.10	.40	.20	− .10	− .10	− .10
7	.48	.50	.55	− .10	1.05	1.00	.10	.35	.15	− .10	− .10	− .10
8	.48	.62	.60	− .10	.95	.98	.12	.35	.12	− .10	− .10	− .10
9	.45	.58	.55	− .08	.92	.90	.10	.35	.10	− .10	− .10	− .10
10	.50	.60	.62	− .10	1.38	.65	.00	.30	.10	− .10	− .08	− .10
11	.45	.52	.60	− .05	1.20	.60	.00	.40	.10	− .10	− .08	− .10
12	.50	.62	.60	− .10	1.05	.55	− .02	.60	.10	− .10	− .10	− .10
13	.50	.60	.50	− .10	.98	.60	− .02	.20	− .10	− .10	− .10	− .10
14	.50	.55	.42	− .10	.98	.65	.00	.00	− .10	− .10	− .10	− .10
15	.65	.58	.40	− .10	.92	.65	− .05	− .10	− .10	− .10	− .10	− .10
16	.55	.50	.30	− .10	.85	.55	.00	− .10	− .10	− .10	− .10	− .10
17	.60	.55	.35	− .10	.80	.65	1.22	− .10	− .10	− .10	− .10	− .10
18	.50	.55	.25	− .05	.68	.50	1.12	− .10	− .15	− .10	− .10	− .10
19	.48	.60	.15	− .08	.68	.60	.55	− .10	− .20	− .10	− .10	− .10
20	.45	.62	.10	− .15	.70	.62	.55	.65	− .20	− .10	− .10	− .10
21	.60	.50	.05	.32	.65	.58	.00	.30	− .20	− .10	− .10	− .10
22	.50	.58	.02	.60	.70	.60	.05	.12	− .20	− .10	− .10	− .10
23	.52	.58	.05	.65	.70	.55	.05	.10	− .10	− .10	− .10	− .10
24	.50	.68	.02	.82	.72	.45	.10	.10	− .10	− .05	− .10	− .10
25	.48	.62	.10	.50	.75	.50	.10	.10	− .10	− .10	− .12	− .10
26	.50	.65	.10	.65	.72	.55	.15	.10	− .10	− .10	− .08	− .10
27	.50	.62	.00	.55	.70	.50	.25	.02	− .10	− .05	− .10	− .10
28	.45	.68	.08	.60	.72	.45	.10	− .05	− .10	− .05	− .10	.00
29	.50	.....	.12	.78	.72	.30	.50	− .05	− .10	− .10	− .10	− .10
30	.50	.....	.12	.90	.92	.20	.30	.20	− .10	− .10	− .10	− .10
31	.65	.....	.08	.....	1.65	.....	1.15	1.10	.....	− .10	.....	− .10
1908.												
1	− .1	− .1	.05	− .1	.1	− .05	− .25	.0	.5	− .2	− .1	− .1
2	− .1	− .1	.05	− .1	.1	− .05	− .25	.0	.4	− .2	− .1	− .1
3	− .1	− .1	.05	− .1	− .1	− .05	− .25	.0	.4	− .2	− .1	− .1
4	− .1	− .1	.05	− .1	− .1	− .05	− .25	.0	.05	− .2	− .1	− .1
5	− .1	− .05	.0	− .1	− .1	− .05	− .25	.0	− .1	− .2	− .1	− .1
6	− .1	.0	.0	− .1	− .1	− .05	− .25	.0	− .2	− .2	− .1	− .1
7	− .1	− .05	.0	− .1	− .1	− .05	− .2	.05	− .2	− .2	− .1	− .1
8	− .1	− .1	− .1	− .1	− .1	− .05	− .2	.1	− .2	− .2	− .1	− .1
9	− .1	− .1	− .1	− .1	− .1	− .05	− .2	.1	− .2	− .2	− .1	− .1
10	− .1	− .1	− .1	− .1	− .1	− .05	− .2	.2	− .2	− .2	− .1	− .1
11	− .1	− .1	− .1	− .1	− .1	− .05	− .2	.2	− .2	− .2	− .1	− .1
12	− .1	− .1	− .1	.1	− .1	− .1	− .2	.2	− .2	− .2	− .1	− .1
13	− .1	− .1	− .1	.2	− .1	− .1	− .2	.4	− .2	− .2	− .1	− .2
14	− .1	− .1	− .1	.2	− .1	− .1	− .2	.65	− .2	− .2	− .1	− .2
15	− .1	− .1	− .1	.2	− .1	− .1	− .2	.55	− .2	− .2	− .1	− .2
16	− .1	− .1	.1	.2	− .1	− .1	− .2	.5	− .2	− .2	− .1	− .2
17	− .1	− .1	.1	.2	− .1	− .1	− .2	.4	− .2	− .2	− .1	− .2
18	− .1	.0	.1	.2	− .1	− .1	− .2	.45	− .2	− .2	− .1	− .2
19	− .1	.0	0	.45	− .1	− .1	− .2	.5	− .2	− .2	− .1	− .2
20	− .1	− .05	− .1	.6	− .1	− .1	− .2	.65	− .2	− .2	− .1	− .2
21	− .1	.0	− .1	.55	− .1	− .1	− .2	.7	− .2	− .2	− .1	− .2
22	− .1	.05	− .1	.6	− .1	− .1	− .2	.9	− .2	− .2	− .1	− .2
23	− .1	.05	− .1	.55	.0	− .1	− .2	.8	− .2	− .2	− .1	− .2
24	− .1	.05	− .1	.55	.0	.1	− .2	.6	− .2	− .2	− .1	− .2
25	− .1	.00	− .1	.55	.0	− .1	− .2	.5	− .2	− .1	− .1	− .2
26	− .1	.05	− .1	.6	.0	− .1	− .2	.5	− .2	− .1	− .1	− .2
27	− .1	.05	− .1	.5	.0	− .1	− .3	.6	− .2	− .1	− .1	− .2
28	− .1	.1	− .1	.2	.0	− .1	− .3	.6	− .2	− .1	− .1	− .2
29	− .1	.05	− .1	.2	.0	− .2	− .3	.5	− .2	− .1	− .1	− .2
30	− .1	.....	− .1	.1	.0	− .2	− .3	.5	− .2	− .1	− .1	− .2
31	− .1	.....	− .1	.....	− .05	.....	.0	.5	.....	− .1	.....	− .2

Rating tables for Sapello River at Los Alamos, N. Mex.

FOR 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	5	.90	32	1.80	189	2.70	522
.10	6	1.00	38	1.90	220	2.80	568
.20	7	1.10	48	2.00	253	2.90	615
.30	9	1.20	60	2.10	287	3.00	664
.40	11	1.30	74	2.20	322	3.20	767
.50	14	1.40	91	2.30	358	3.40	875
.60	17	1.50	111	2.40	396	3.60	986
.70	21	1.60	134	2.50	436	3.80	1,100
.80	26	1.70	160	2.60	478		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1905 and is not well defined.

JANUARY 1 TO MAY 10, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	4	1.00	26	1.40	66	1.80	133
.60	7	1.10	34	1.50	80	1.90	155
.70	11	1.20	43	1.60	96	2.00	180
.80	15	1.30	54	1.70	114	2.10	208
.90	20						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during March and April, 1906, and is not well defined.

MAY 11, 1906, TO SEPTEMBER 12, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.20	2.1	0.80	50	1.70	184	2.60	570
−0.10	3.5	.90	59	1.80	214	2.70	620
0.00	5.6	1.00	69	1.90	250	2.80	675
.10	8	1.10	80	2.00	290	2.90	730
.20	11	1.20	92	2.10	330	3.00	785
.30	15	1.30	105	2.20	375	3.20	895
.40	20	1.40	120	2.30	420	3.40	1,005
.50	26	1.50	138	2.40	470	3.60	1,115
.60	33	1.60	159	2.50	520	3.80	1,225
.70	41						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 12 discharge measurements made during 1906 and 1907 and is well defined between gage heights—0.20 foot and 1.25 feet. Above this it is based on one measurement in 1905 and is somewhat uncertain.

SEPTEMBER 13, 1907, TO SEPTEMBER 3, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.30	0.5	0.10	6.5	0.50	34	0.80	70
−0.20	1.0	.20	11	.60	44	.90	85
−0.10	1.5	.30	17	.70	56	1.00	102
0.00	3.0	.40	25				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908 and 1909 and is not well defined.

SEPTEMBER 4 TO DECEMBER 31, 1908.

To allow for slight changes in conditions of flow after September 3, 1908, the discharge September 4 to October 31 has been estimated 1.0 second-foot greater than that given by the preceding table, and the discharge November 1 to December 31 has been estimated 0.5 second-foot greater than that given by the preceding table.

Monthly discharge of Sapello River at Los Alamos, N. Mex., for 1905 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
February 3–28	160	32	60.7	3,130	C.
March	545	54	120	7,380	C.
April	1,100	111	289	17,200	C.
May	457	91	187	11,500	C.
June	101	10	42.3	2,520	C.
July	82	5	9.47	582	D.
August	74	6	17.0	1,050	C.
September	29	6	7.55	449	
October	6	6	6.00	369	
November	220	6	18.1	1,080	
December	26	14	15.5	953	
The period				46,200	
1906.					
January	86	4	31.5	1,940	
February	20	15	15.5	861	
March	38	11	16.5	1,010	C.
April	194	38	54.2	3,230	C.
May	172	23	64.3	3,950	D.
June	86	3.5	25.0	1,490	C.
July	80	3.5	18.6	1,140	C.
August	15	2.4	7.95	489	C.
September	46	1.8	7.30	434	C.
October	13	2.8	8.88	546	D.
November	16	10	12.0	714	D.
December	1,170	16	120	7,380	
The year	1,170	1.8	31.8	23,200	
1907.					
January	37	23	26.6	1,640	
February	39	21	31.6	1,760	
March	35	4.6	19.7	1,210	
April	59	2.8	14.8	881	C.
May	172	37	64.2	3,950	A.
June	148	11	48.7	2,900	A.
July	95	4.6	15.1	928	B.
August	80	3.5	19.2	1,180	B.
September	50	1.0	6.62	394	
October	2.2	1.5	1.57	96.5	
November	1.8	1.4	1.54	91.6	
December	1.5	1.5	1.50	92.2	
The year	172	1.0	20.9	15,100	
1908.					
January	1.5	1.5	1.50	92.2	
February	6.5	1.5	2.69	155	
March	6.5	1.5	2.60	160	
April	44	1.5	15.6	928	D.
May	6.5	1.5	2.23	137	
June	2.2	1.0	1.72	102	
July	3.0	.5	.96	59.0	
August	85	3.0	28.0	1,720	C.
September	34	2.0	4.71	280	
October	2.5	2.0	2.11	130	
November	2.0	2.0	2.00	119	
December	2.0	1.5	1.69	104	
The year	85	0.5	5.49	3,990	

NOTE.—Accuracy values can not be given for many of the above monthly means for 1905–8. Some of the inaccuracies are due to insufficient measurements to cover known radical changes in conditions of flow; others are due to very low discharge, which have only relative value.

NORTH FORK OF CANADIAN RIVER NEAR ELRENO, OKLA.

This station, which was established October 27, 1902, to obtain information concerning the flood flow of the river, was located at the highway bridge 2 miles north of Elreno, Okla. Gage observations were discontinued on April 30, 1908. The station was about 150 miles above the junction of the North Canadian with the Canadian, but no important tributaries enter below.

The bed of the stream is sandy and shifting, and frequent discharge measurements are necessary to obtain the best results. No change was made in the datum of the gage during the maintenance of the station.

Discharge measurements of North Fork of Canadian River near Elreno, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 11	W. A. Lamb	106	243	4.26	490
April 12	do	115	195	3.75	346
December 4	R. L. Cooper	103	147	3.30	199
1908.					
January 28	R. L. Cooper	105	161	3.50	243
February 18	do	110	260	4.45	535

Daily gage height, in feet, of North Fork of Canadian River near Elreno, Okla., for 1907 and 1908.

[Austin Clift, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.2	4.7	3.7	3.1	3.2	3.7	6.4	3.5	2.9	2.1	3.4	3.4
2	4.2	4.6	3.7	3.0	3.2	3.6	6.0	3.4	2.9	2.6	3.3	3.4
3	4.2	4.9	3.8	3.0	3.4	3.6	5.4	3.2	3.4	3.0	3.3	3.3
4	4.2	4.8	3.8	3.5	3.4	3.5	5.0	4.0	3.2	3.3	3.3	3.3
5	4.1	5.0	3.7	4.6	3.4	3.5	4.8	4.5	2.9	3.3	3.3	3.3
6	4.1	5.4	3.7	5.0	3.4	3.4	4.4	5.0	2.9	3.5	3.3	3.3
7	4.1	5.0	3.7	4.9	3.4	3.3	3.4	5.7	2.9	3.5	3.2	3.2
8	4.1	4.8	3.7	4.8	3.3	3.3	3.4	6.0	2.8	3.5	3.2	3.2
9	4.1	4.8	3.7	4.8	3.3	9.8	3.4	6.0	2.7	3.4	3.2	3.2
10	4.1	4.7	3.7	4.6	3.3	8.4	3.6	5.8	2.7	3.4	3.2	3.3
11	4.2	4.6	3.7	4.5	3.2	5.2	4.1	5.0	2.7	3.4	3.2	3.3
12	4.3	4.3	3.7	4.2	3.4	5.0	4.0	4.6	2.6	3.2	3.2	3.3
13	4.3	4.4	3.7	4.0	3.4	4.5	3.8	4.0	2.5	3.2	3.1	3.3
14	4.3	4.4	3.6	3.9	3.5	4.0	3.8	3.2	2.5	3.0	3.1	3.3
15	4.3	4.4	3.6	3.5	3.5	3.6	3.7	2.8	2.5	3.0	3.1	3.3
16	4.5	4.4	3.6	3.4	3.4	3.5	3.6	2.7	2.5	3.3	3.1	3.3
17	4.7	4.3	3.6	3.4	3.4	3.4	3.5	2.7	2.5	3.4	3.1	3.4
18	4.9	4.0	3.5	3.2	3.4	3.3	3.5	2.7	2.3	3.4	3.1	3.4
19	5.0	4.0	3.5	3.2	3.4	3.2	3.5	2.7	2.3	3.4	3.1	3.4
20	5.4	3.9	3.5	3.0	3.4	3.4	3.2	2.6	2.3	3.4	3.4	3.4
21	5.4	3.8	3.5	3.2	3.4	3.6	3.2	2.6	2.3	3.4	3.3	3.4
22	5.4	3.8	3.5	3.2	3.4	4.0	3.3	2.8	2.3	3.4	3.3	3.8
23	5.2	3.8	3.4	3.2	3.4	3.8	3.3	2.8	2.1	3.4	3.3	3.9
24	5.0	3.8	3.4	3.2	4.2	3.4	3.2	3.0	2.1	3.4	3.3	3.8
25	4.8	3.7	3.4	3.2	3.8	3.0	3.1	3.5	2.1	3.3	3.5	3.8
26	4.8	3.7	3.4	3.3	4.0	3.0	3.0	3.6	2.1	3.3	3.5	3.8
27	4.8	3.7	3.3	3.3	4.0	3.6	3.0	3.8	2.1	3.8	3.5	3.7
28	4.6	3.7	3.3	3.2	3.9	8.0	3.0	3.6	2.1	4.3	3.5	3.6
29	4.6	.....	3.3	3.2	3.8	7.8	2.9	3.4	2.1	4.0	3.4	3.6
30	4.6	.....	3.3	3.2	3.7	7.5	3.0	3.2	2.1	3.6	3.4	3.6
31	4.7	.....	3.2	.....	3.7	.....	4.2	3.0	.....	3.5	.....	3.4

Daily gage height in feet, of North Fork of Canadian River near Elreno, Okla., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1908.					1908.				
1	3.4	3.2	4.0	3.3	16	3.5	3.7	3.6	3.6
2	3.4	3.2	4.0	3.3	17	3.5	4.0	3.6	3.9
3	3.7	2.9	3.8	3.3	18	3.5	4.1	3.6	3.9
4	3.9	2.9	3.8	3.3	19	3.5	4.1	3.6	3.9
5	3.8	2.8	3.8	3.3	20	3.5	4.1	3.4	3.9
6	3.8	2.8	3.8	3.3	21	3.5	4.1	3.4	3.8
7	3.8	2.8	3.8	3.3	22	3.6	4.1	3.4	3.8
8	3.7	2.7	4.0	3.3	23	3.6	4.1	3.4	3.8
9	3.6	2.7	4.0	3.3	24	3.6	4.1	3.3	3.7
10	3.6	2.7	3.8	3.6	25	3.5	4.1	3.3	3.7
11	3.5	2.7	3.7	3.8	26	3.5	4.1	3.3	3.6
12	3.5	3.0	3.6	3.8	27	3.5	4.0	3.2	3.5
13	3.5	3.5	3.6	3.6	28	3.2	4.0	3.2	3.3
14	3.5	3.5	3.6	3.6	29	3.2	4.0	3.2	3.3
15	3.5	3.7	3.6	3.6	30	3.2	.....	3.2	3.3
					31	3.2	.....	3.2	.....

Rating table for North Fork of Canadian River near Elreno, Okla., for 1906–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	40	3.50	280	4.90	631	6.60	1,300
2.20	51	3.60	302	5.00	660	6.80	1,400
2.30	63	3.70	325	5.10	690	7.00	1,510
2.40	76	3.80	348	5.20	725	7.20	1,630
2.50	90	3.90	371	5.30	760	7.40	1,750
2.60	105	4.00	395	5.40	795	7.60	1,875
2.70	121	4.10	419	5.50	830	7.80	2,005
2.80	138	4.20	444	5.60	870	8.00	2,140
2.90	156	4.30	469	5.70	910	8.20	2,280
3.00	175	4.40	494	5.80	950	8.40	2,420
3.10	195	4.50	520	5.90	990	8.60	2,560
3.20	215	4.60	547	6.00	1,030	8.80	2,700
3.30	236	4.70	574	6.20	1,115	9.00	2,840
3.40	258	4.80	602	6.40	1,205	10.00	3,640

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1906–1908 and is well defined between gage heights 2.7 feet and 8 feet.

Monthly discharge of North Fork of Canadian River near Elreno, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	795	419	451	33,300	B.
February	795	325	484	26,900	B.
March	348	215	293	18,000	B.
April	660	175	325	19,300	B.
May	444	215	282	17,300	B.
June	3,480	175	662	39,400	B.
July	1,200	156	369	22,700	B.
August	1,030	105	362	22,300	B.
September	258	40	98.1	5,840	C.
October	469	40	250	15,400	C.
November	280	195	231	13,700	C.
December	371	215	268	16,500	B.
The year	3,480	40	347	251,000	
1908.					
January	371	215	286	17,600	B.
February	419	121	289	16,600	B.
March	395	215	298	18,300	B.
April	371	236	293	17,400	B.
The period	.....	.....	.....	69,900	

RED RIVER DRAINAGE BASIN.

DESCRIPTION.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low swampy region in Louisiana into the Mississippi not far from the southern boundary of the State of Mississippi.

North Fork and Salt Fork rise in the Panhandle of Texas and flow in a general southeasterly course across the southwest corner of Oklahoma, uniting with Prairie Dog Fork a short distance above Vernon, Tex. Elm Fork, rising in the same locality, joins North Fork 50 or 75 miles above its mouth. The flow is very uncertain, most of the run-off being flood water from heavy rains. The flow ceases entirely in the late summer and fall in ordinary dry years. The drainage area consists of dry, semi-arid plains varied by sandhills in some portions. The underlying rocks are sandstone, limestone, and gypsum in the upper portion and granite where the streams pass through the Wichita Mountains.

Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming a boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the Louisiana boundary line. The flow of this river varies greatly, changing with the rainfall. If the summer is at all dry it ceases altogether, but enough water always remains standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress Creek has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases and the river becomes dry except where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

Gaging stations have been maintained in the basin as follows:

Red River at Arthur City, Tex., 1905–6.
Red River (Salt Fork) at Mangum, Okla., 1905–6.
Turkey Creek near Olustee, Okla., 1905–1908.
Red River (North Fork) near Granite, Okla., 1903–1908.
Red River (North Fork) near Snyder, Okla., 1905.
Red River (North Fork) near Headrick, Okla., 1905–1908.
Red River (Elm Fork) near Mangum, Okla., 1905–1908.
Elk Creek near Hobart, Okla., 1904–1908.
Otter Creek near Mountain Park, Okla., 1903–1908.
Horse Creek near Mountain Park, Okla., 1905–6.
Otter Creek (Dry Fork) near Mountain Park, Okla., 1905–6.
Washita River near Anadarko, Okla., 1902–1908.

TURKEY CREEK NEAR OLUSTEE, OKLA.

This station, which was established April 20, 1905, and abandoned March 31, 1908, was located about 200 feet downstream from William Fullerton's irrigation dam, 6 miles northwest of Olustee, Okla. This dam furnishes power for pumping water to irrigate about 50 acres of land on William Fullerton's farm.

The datum of the gage remained constant during the maintenance of the station. Only the estimates of the low-water discharge are at all reliable, as not enough measurements were taken at high and medium stages.

Discharge measurements of Turkey Creek near Olustee, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 6	W. A. Lamb	19	16	2.90	34
March 8	do	18	15	2.90	28
April 7	Lamb and Cooper	18	11	2.76	25
May 3	do	18	11	2.70	22
June 5	R. L. Cooper	20	11	2.80	42
June 15[a]	W. A. Lamb	19	50	3.75	63
July 12	R. L. Cooper	20	19	3.00	38
August 9	do	18	14	2.75	30
October 12	do	13	7	2.50	18
December 11	do	13	9	2.55	17
1908.					
January 22[b]	R. L. Cooper	14	9	2.58	15
February 25	do	15	10	2.70	16
March 26[c]	do	15	10	2.60	14.5

[a] Measurement from bridge, one-half mile below gage.
[b] Discharge of Fullerton's Canal was 2.5 second-feet.
[c] Discharge of Fullerton's Canal was 3.3 second-feet.

Daily gage height, in feet, of Turkey Creek near Olustee, Okla., for 1907 and 1908.

[J. A. Conger, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	2.8	3.0	2.9	2.8	2.8	3.8	2.9	2.6	2.4	2.3	2.5	2.5
2	2.8	3.0	2.9	2.8	2.7	3.2	2.9	2.75	2.35	2.3	2.5	2.5
3	2.8	3.0	2.9	2.8	2.7	3.1	2.8	5.8	2.25	3.0	2.5	2.5
4	2.8	2.9	2.9	2.8	2.7	2.9	2.8	7.0	2.25	10.05	2.5	2.5
5	2.8	2.9	2.9	2.8	3.85	2.8	2.8	2.75	2.2	6.3	2.5	2.5
6	2.8	2.9	2.9	2.7	3.0	2.8	2.8	2.65	2.25	2.7	2.5	2.5
7	2.8	2.9	2.9	2.7	2.7	2.8	2.7	2.6	2.25	2.6	2.5	2.5
8	2.8	2.9	2.9	2.7	2.7	2.8	2.7	2.6	2.2	2.6	2.5	2.5
9	7.6	2.9	2.9	2.7	2.7	17.3	2.7	2.6	2.2	2.5	2.5	2.5
10	12.0	2.9	2.9	2.7	2.85	16.0	2.7	2.5	2.3	2.5	2.5	2.5
11	5.5	2.9	2.9	2.7	2.75	7.1	2.8	2.6	2.5	2.5	2.5	2.5
12	3.7	2.9	2.9	2.7	2.65	4.55	2.7	2.6	2.65	2.5	2.5	2.5
13	3.3	2.8	2.9	2.7	2.6	6.6	2.7	2.65	2.5	2.5	2.5	2.5
14	3.2	2.8	2.9	2.7	2.6	4.0	2.7	2.55	2.3	2.5	2.5	2.5
15	3.2	2.8	2.9	2.7	2.6	3.7	2.7	2.6	2.3	.....	2.5	2.5
16	3.2	2.8	2.9	2.7	2.6	3.5	2.7	2.6	2.6	.....	2.5	2.5
17	3.1	2.8	2.9	2.7	2.6	3.3	2.7	2.6	2.3	.....	2.5	2.6
18	3.0	2.8	2.9	2.7	2.6	3.6	2.6	2.75	2.5	.....	2.5	2.6
19	10.0	2.8	2.9	2.7	2.6	4.3	2.6	2.6	2.5	.....	2.5	2.6
20	7.55	2.8	2.9	2.7	2.6	3.8	2.6	2.4	5.35	.....	2.5	2.6
21	3.5	2.8	2.8	2.7	2.6	4.25	2.6	2.4	2.6	.....	2.5	2.75
22	3.2	2.8	2.8	2.7	2.6	3.9	2.6	2.65	2.5	.....	2.5	3.6
23	3.2	2.8	2.8	2.7	2.6	3.3	2.6	2.4	2.25	.....	2.5	3.3
24	3.1	2.8	2.8	2.7	7.8	3.2	2.55	2.3	2.3	2.4	2.5	2.6
25	3.0	2.8	2.8	2.7	12.85	4.7	2.55	2.25	2.2	2.4	2.5	2.6
26	3.0	2.8	2.8	2.7	4.05	3.1	2.6	2.7	2.3	.....	2.5	2.6
27	3.0	2.8	2.8	2.7	2.8	3.0	2.55	2.75	2.3	.....	2.5	2.6
28	3.0	2.9	2.8	2.7	4.0	3.0	2.65	2.6	2.3	.....	2.5	2.6
29	3.0	.....	2.8	2.8	10.0	3.0	2.6	2.45	2.3	.....	2.5	2.6
30	3.0	.....	2.8	2.9	14.05	2.9	2.6	2.4	2.3	2.7	2.5	2.6
31	3.0	.....	2.8	.....	9.45	.....	2.6	2.3	.....	2.6	.....	2.6

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	2.6	2.6	2.7	11	2.5	2.6	2.6	21	2.5	2.7	2.5
2	2.6	2.6	2.7	12	2.5	2.6	2.6	22	2.5	2.7	2.5
3	2.6	2.6	2.7	13	2.5	2.6	2.6	23	2.5	2.7	2.5
4	2.7	2.6	2.7	14	2.5	2.6	2.6	24	2.5	2.7	2.5
5	2.7	2.6	2.7	15	2.5	2.6	2.6	25	2.5	2.7	2.5
6	2.6	2.6	2.6	16	2.5	2.6	2.6	26	2.5	2.7	2.5
7	2.6	2.6	2.6	17	2.5	2.6	2.6	27	2.5	2.7	2.4
8	2.6	2.6	2.6	18	2.5	2.7	2.6	28	2.5	2.7	2.4
9	2.5	2.6	2.6	19	2.5	2.7	2.6	29	2.6	2.7	2.4
10	2.5	2.6	2.6	20	2.5	2.7	2.6	30	2.6	.....	2.4
								31	2.6	.....	2.4

[a] There was no flow at gage October 15–23 and October 26–29, 1907. Excessive gage heights of September 20 and October 4, 1907, were caused by failure of dam above station.

Daily discharge, in second-feet, of Turkey Creek near Olustee, Okla., for 1907 and 1908.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1907.				1907.				1907.			
1	.....	18	16	11	18	18	16	21	15	17	21
2	.....	18	16	12	18	17	16	22	15	17	52
3	.....	18	16	13	18	17	16	23	15	17	40
4	.....	18	16	14	18	17	16	24	15	17	17
5	.....	18	16	15	17	17	15	25	15	17	17
6	.....	18	16	16	17	17	15	26	15	17	17
7	.....	18	16	17	17	17	17	27	16	17	17
8	.....	18	16	18	16	17	17	28	18	17	17
9	18	18	16	19	16	17	17	29	21	17	17
10	18	18	16	20	16	17	17	30	24	17	17
								31	20	.....	17

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	17	15	16	11	15	15	14	21	13	16	13
2	17	15	16	12	15	15	14	22	13	16	13
3	17	15	15	13	15	15	14	23	13	16	13
4	20	15	15	14	14	15	14	24	13	16	13
5	20	15	15	15	14	14	15	25	13	16	13
6	17	15	14	16	14	14	15	26	13	16	13
7	17	15	14	17	14	14	15	27	13	16	11
8	17	15	14	18	13	17	15	28	13	16	11
9	15	15	14	19	13	17	15	29	15	16	11
10	15	15	14	20	13	17	15	30	15	.....	11
								31	15	.....	11

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Turkey Creek near Olustee, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
October 9–31	24	15	17.2	785
November	18	17	17.4	1,040
December	52	15	18.4	1,130
1908.				
January	20	13	14.9	916
February	17	14	15.4	886
March	16	11	13.7	842

NOTE.—Owing to the shifting character of the stream bed at this point the above values of mean monthly discharge can only be classed as fair (C).

NORTH FORK OF RED RIVER NEAR GRANITE, OKLA.

This station, which was established June 23, 1903, in connection with the proposed Red River (Otter Creek) project of the United States Reclamation Service, and was abandoned on March 20, 1908, was located at the highway bridge 2 miles east and one-half mile north of Granite, Okla., near the crossing of the Chicago, Rock Island and Pacific Railway. The locality is about 10 miles above the mouth of Elm Fork. The Lugert reservoir site, above the mouth of Elm Fork, has a capacity of nearly 90,000 acre-feet with a dam 70

feet high. Very little use is made of the stream above this point as the average annual rainfall is about 30 inches, and when this rainfall is properly distributed, irrigation is not necessary.

The datum of the gage remained unchanged during the continuance of the station. Owing to the sandy and shifting nature of the stream bed the river sometimes flows in a number of channels, while at other times it is confined practically to one channel near either end of the pile bridge which has a span of several hundred feet. On this account an auxiliary chain gage, which was moved to various points along the bridge to conform with the shifting of the channel, was used in addition to the permanent gage.

Thin ice sometimes forms on this stream but rarely has any appreciable effect on the flow.

Discharge measurements of North Fork of Red River near Granite, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 10	W. A. Lamb	74	119	7.00	204
March 11	do	87	68	7.17	95
April 10	Lamb and Cooper	86	45	6.90	54
April 15	R. L. Cooper	88	36	6.82	39
April 19	do	25	25	6.79	21
April 23	do	248	202	7.35	238
April 26	do	128	90	6.96	110
May 1	do	155	211	7.46	371
May 11	do	142	80	7.05	91
May 17 [a]	do	40	19	6.70	25
May 22	do	40	24	6.60	13
June 3	do	126	71	7.00	94
June 18	Lamb and Cooper	69	43	6.75	58
June 19	do	561	714	9.00	3,130
June 20	R. L. Cooper	217	254	7.45	667
June 23	do	93	70.7	.....	93.9
June 25	do	302	860	8.62	2,710
June 28	do	137	358	7.70	657
July 5	do	123	85	.....	89
July 10	do	119	127	6.52	155
July 17	do	130	180	6.95	225
July 22	do	97	53	6.57	47
July 25	do	67	27	6.35	18
July 29	do	69	28	6.35	17
August 2	do	92	46	6.50	48
August 3	do	326	1,340	9.00	5,480
August 4	do	81.5	520	7.90	1,220
August 7	do	112	92	6.79	165
August 14	do	66.5	49	6.90	45
August 15	do	46.5	39	6.75	38
August 19	do	36.5	11	6.50	7
August 23	do	121.5	113	7.40	277
August 27	do	76.5	55	7.00	78
August 30	do	17.5	17	6.50	14
October 6	do	140	109	6.90	386
October 9	do	130	90	6.95	159
October 14	do	110	68	6.80	109
October 18	do	88	53	6.75	92
October 22	do	134	91	6.92	150
October 30	do	130	149	7.00	349
December 13	do	.....	90	7.00	101
December 26	do	90	164	7.20	199
1908.					
January 23	R. L. Cooper	98	99	7.28	115
January 29	do	116	86	7.30	86
February 7	do	165	130	7.55	153
February 26 [b]	do	152	89	7.35	148
March 20 [b]	do	.....	56	7.20	72

[a] Wading measurement. [b] Measured from railroad bridge.

Daily gage height, in feet, of North Fork of Red River near Granite, Okla., for 1907 and 1908.

[Elmer O. Tompkins, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	7.0	7.15	7.3	6.85	7.45	7.15	.....	6.25	6.25	9.4	7.0	7.2
2	7.1	7.1	7.05	6.85	7.3	7.0	.....	6.4	.....	7.85	6.95	7.2
3	7.1	7.0	7.3	6.85	7.2	7.05	.....	10.25	.....	10.0	6.95	7.15
4	7.1	6.95	.....	7.6	7.1	7.2	.....	7.9	.....	9.9	6.95	7.2
5	7.0	6.4	7.2	7.75	7.15	7.25	.....	7.85	.....	7.5	6.95	7.2
6	6.8	6.7	7.1	7.25	7.3	7.2	.....	6.9	.....	6.95	6.90	7.2
7	6.9	7.3	7.1	7.1	7.2	7.3	6.3	6.75	.....	7.0	.....	7.2
8	6.9	7.2	7.1	7.0	7.15	7.2	6.2	6.7	6.25	6.95	.....	7.2
9	7.9	7.5	7.1	6.95	7.25	9.3	6.15	7.65	6.6	6.9	.....	7.2
10	8.12	7.0	7.1	6.9	7.15	8.5	6.15	7.65	7.4	6.95	.....	7.15
11	7.75	6.95	7.2	6.9	7.1	7.7	7.1	6.65	7.05	6.95	.....	7.15
12	7.4	6.9	7.15	6.85	7.0	7.8	7.05	6.6	7.0	6.9	.....	7.1
13	7.15	6.95	7.1	6.85	6.9	7.5	6.55	.....	7.0	6.8	.....	7.1
14	7.0	6.8	7.1	6.85	6.9	7.45	6.35	6.9	6.85	6.85	.....	7.1
15	7.0	7.1	7.1	6.85	.....	7.3	6.25	6.6	.....	6.8	.....	7.1
16	7.5	6.9	7.1	6.8	.....	7.25	7.35	6.75	.....	6.8	.....	7.1
17	7.0	7.0	7.1	6.8	6.7	7.2	7.05	6.75	.....	6.8	.....	7.1
18	7.0	7.0	7.0	6.8	.....	7.2	6.85	6.7	.....	6.75	7.0	7.1
19	8.62	7.0	6.8	6.8	6.6	8.12	6.7	6.65	.....	6.75	7.05	7.1
20	8.5	7.1	7.0	6.85	6.6	7.85	6.6	6.6	.....	6.9	8.5	7.1
21	7.35	6.95	7.1	6.95	6.7	9.8	6.55	6.75	.....	6.9	7.4	7.15
22	7.05	7.05	7.05	7.1	6.6	8.45	6.55	6.8	.....	6.9	7.3	7.1
23	6.95	7.0	6.9	7.3	6.6	6.95	6.5	7.5	.....	6.9	6.9	.....
24	7.0	7.05	6.8	7.25	8.7	6.95	6.45	7.4	.....	6.9	6.9	.....
25	6.95	7.1	6.8	7.15	7.85	9.2	6.35	7.25	.....	6.9	6.9	.....
26	7.0	7.0	6.9	7.05	7.3	7.45	6.3	7.05	.....	6.8	6.95	7.1
27	7.0	7.2	6.85	7.05	7.1	7.35	6.35	7.0	.....	.....	7.2	7.1
28	6.85	7.1	6.9	7.0	7.1	7.7	6.3	6.95	.....	6.9	7.15	7.1
29	6.95	.....	6.85	7.15	7.15	.....	6.35	.....	6.0	6.9	7.25	7.1
30	7.0	.....	6.85	7.45	7.6	.....	6.3	6.5	6.0	6.95	7.2	7.1
31	7.2	.....	6.85	.....	7.15	.....	6.3	.....	.....	7.0	.....	7.1

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	.....	7.3	7.35	11	.....	7.45	7.45	21	7.3	7.3	.....
2	.....	7.3	7.35	12	.....	7.4	7.4	22	7.3	7.4	.....
3	.....	7.3	7.3	13	.....	7.35	7.3	23	7.3	7.1	.....
4	7.3	7.3	7.3	14	.....	7.4	7.3	24	7.3	7.2	.....
5	7.5	7.3	7.3	15	6.7	7.25	7.3	25	7.3	7.3	.....
6	7.35	7.3	7.3	16	7.05	7.7	7.3	26	7.3	7.4	.....
7	.....	7.45	7.25	17	7.1	7.45	7.2	27	7.3	7.45	.....
8	.....	7.45	7.3	18	7.15	7.85	7.2	28	7.3	7.45	.....
9	.....	7.45	7.35	19	7.55	7.45	.....	29	7.3	7.45	.....
10	.....	7.45	7.4	20	7.5	7.15	7.2	30	7.3	.....	.....
								31	7.3	.....	.....

NOTE.—Water standing in pools September 26–30, 1907. Channel shifted, leaving gage out of water on days for which no gage heights are given.

Daily discharge, in second-feet, of North Fork of Red River near Granite, Okla., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	140	270	190	30	370	160	150	10	5	3,800	360	270
2	180	250	100	30	290	100	100	25	5	1,460	330	270
3	180	200	190	30	240	120	100	7,500	5	6,000	330	220
4	180	180	170	320	210	180	100	1,220	5	5,500	320	250
5	140	10	150	400	200	200	90	1,150	5	1,000	320	250
6	70	90	70	180	260	180	60	200	5	420	290	230
7	100	340	70	120	210	220	25	150	5	420	290	230
8	100	300	70	90	180	200	20	130	5	300	290	230
9	660	450	70	70	210	3,000	20	550	40	120	280	200
10	800	200	70	60	160	1,800	30	520	380	160	280	180
11	500	180	100	60	110	430	400	50	210	160	280	160
12	340	160	90	40	80	510	370	20	200	140	280	140
13	220	180	70	40	45	350	120	30	200	110	280	140
14	160	120	70	40	40	320	110	45	130	120	280	140
15	160	250	70	40	35	250	10	40	110	110	270	140
16	400	160	80	25	30	250	560	40	100	110	270	140
17	160	160	80	25	25	230	300	40	90	110	270	140
18	160	160	50	25	20	230	160	20	80	92	260	140
19	1,500	160	10	25	10	1,460	100	10	70	92	280	140
20	1,400	200	50	40	10	1,140	70	10	60	140	520	150
21	350	140	100	80	35	5,000	40	40	50	140	440	170
22	200	180	80	130	15	2,050	40	60	40	140	390	150
23	160	120	30	220	15	95	40	320	30	160	200	150
24	180	140	10	200	1,600	95	40	270	20	180	200	150
25	160	160	10	180	600	4,000	18	190	10	200	200	150
26	180	120	40	140	260	740	13	100	0	180	200	160
27	180	200	25	140	160	470	18	78	0	210	290	160
28	120	160	40	140	160	660	12	60	0	240	270	160
29	160	.....	25	200	180	600	17	40	0	260	320	160
30	180	.....	25	370	380	400	12	14	0	300	270	160
31	270	.....	25	.....	180	.....	12	10	.....	350	.....	160

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	170	75	150	11	100	130	175	21	130	110	.....
2	190	70	150	12	60	115	155	22	125	150	.....
3	200	70	130	13	40	100	120	23	120	50	.....
4	215	70	130	14	20	120	120	24	115	80	.....
5	290	70	135	15	10	75	115	25	110	120	.....
6	220	65	120	16	60	250	115	26	100	170	.....
7	200	135	105	17	75	150	75	27	90	190	.....
8	170	135	120	18	90	340	75	28	90	190	.....
9	140	130	140	19	250	260	75	29	86	190	.....
10	120	130	155	20	220	60	72	30	80	.....	.....
								31	80	.....	.....

NOTE.—These discharges were obtained by the indirect methods for shifting channels. Discharge estimated on days of no gage reading.

Monthly discharge of North Fork of Red River near Granite, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	1,500	70	313	19,200
February	450	10	187	10,400
March	190	10	71.9	4,420
April	400	25	116	6,900
May	1,600	10	204	12,500
June	5,000	95	848	50,500
July	560	10	102	6,270
August	7,500	10	417	25,600
September	380	0	62.0	3,690
October	6,000	92	733	45,100
November	520	200	295	17,600
December	270	140	177	10,900
The year	7,500	0	294	213,000
1908.				
January	290	10	128	7,870
February	340	50	131	7,540
March 1–20	175	72	121	4,800

NOTE.—Owing to the shifting character of the stream bed at this point the above values of mean monthly discharge can only be classed in general as fair (C) and some months are only approximate (D).

NORTH FORK OF RED RIVER NEAR HEADRICK, OKLA.

This station, which was established July 17, 1905, to obtain data for use in connection with the proposed Red River (Otter Creek) project of the United States Reclamation Service, was abandoned March 30, 1908. It was located at the Navajo dam site, about 4 miles northeast of Headrick and 8 miles west of Mountain Park, Okla., a few miles below the mouth of Elk Creek and about an equal distance above the mouth of Otter Creek. The drainage area above the station comprises some 5,500 square miles.

The Navajo reservoir site has a capacity of over 300,000 acre-feet with a dam 75 feet high above the river bed. By means of a flood-water canal the Salt Fork of Red River, with a drainage of 1,200 square miles, could be diverted into this reservoir.

No change was made in the datum of the gage during the continuance of the station.

The stream bed is very shifting in character, but as a large number of discharge measurements have been made the results are considered very satisfactory.

Discharge measurements of North Fork of Red River near Headrick, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 7	W. A. Lamb	190	284	3.90	619
March 9	do	181	259	3.55	435
March 15	do	182	245	3.50	320
April 8	Lamb and Cooper	155	232	3.43	318
April 12	R. L. Cooper	113	178	3.11	270
April 18	do	108	138	3.00	142
April 25	do	152	242	3.38	280
April 30	do	225	357	3.78	494
May 4	do	227	409	4.00	686
May 10	do	169	270	3.42	365
May 21	do	171	201	3.41	309
May 26	do	231	771	4.60	2,780
May 31	do	242	769	4.75	2,560
June 8	do	224	320	3.60	545
June 16	W. A. Lamb	220	431	2.90	581
June 21	R. L. Cooper	231	520	4.18	1,420
Do	do	250	1,180	5.98	7,140
July 9	do	220	201	3.00	326
July 15	do	222	261	3.30	395
July 19	do	222	248	3.15	362
July 24	do	220	126	2.82	201
August 1	do	186	162	2.60	211
August 12	do	160	166	2.85	274
August 17	do	150	118	2.55	160
August 22	do	150	118	2.45	109
August 29	do	180	166	2.60	226
September 5	do	193	116	2.45	123
September 10	do	210	249	2.80	317
September 22	do	69	53	2.55	60
October 4	do	264	1,440	6.40	9,580
October 8	do	197	477	3.50	918
October 13	do	190	288	3.00	477
November 2	do	195	274	3.15	442
November 7	do	193	196	2.90	298
November 21	do	193	217	3.10	359
November 29	do	194	212	2.95	345
December 12	do	179	165	2.85	246
December 28	do	185	209	3.00	307
1908.					
January 21	R. L. Cooper	167	182	3.25	266
January 30	do	162	128	3.22	214
February 5	do	157	122	3.17	202
February 12	do	143	148	3.20	193
February 23	do	220	200	3.30	352
February 27	do	220	211	3.40	372
March 4	do	202	143	3.20	197
March 9	do	202	141	3.20	191
March 13	do	222	163	3.20	241
March 24	do	206	110	3.10	151

Daily gage height, in feet, of North Fork of Red River near Headrick, Okla., for 1907 and 1908.

[Elmer Jasper and J. N. Jasper, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.65	4.10	3.60	3.08	4.42	4.15	3.45	2.58	2.50	5.95	3.40	2.85
2	3.60	3.85	3.75	3.08	3.92	3.90	3.35	2.80	.....	4.85	3.35	2.88
3	3.60	3.95	3.68	3.05	3.70	3.72	3.30	4.48	2.48	7.90	3.12	2.85
4	3.60	3.90	3.70	3.12	3.95	3.60	3.30	4.60	2.45	4.50	3.02	2.85
5	3.60	3.62	3.58	3.52	4.05	3.58	3.30	4.38	2.45	2.40	3.02	2.82
6	3.60	3.62	3.50	4.15	3.90	3.85	3.15	3.70	2.42	5.95	3.00	3.90
7	3.55	3.75	3.48	3.75	4.68	3.80	3.10	3.35	2.40	.....	2.98	3.38
8	3.55	3.88	3.45	3.45	3.92	3.55	3.02	3.15	2.40	.....	2.92	2.90
9	4.35	3.95	3.55	3.30	3.60	7.45	3.00	3.10	2.50	.....	2.72	2.88
10	5.35	3.88	3.50	3.22	3.45	6.25	2.95	2.98	3.00	3.42	.....	2.88
11	4.10	3.80	3.50	3.15	3.28	4.88	3.68	2.90	3.72	3.30	2.80	2.85
12	4.02	3.65	3.50	3.08	3.00	4.50	4.42	2.82	3.18	3.25	2.80	2.85
13	3.95	3.60	3.48	3.05	3.08	3.70	3.75	2.75	2.90	.....	2.80	2.82
14	3.98	3.55	3.48	3.00	3.10	3.18	3.38	2.65	2.80	3.00	2.85	2.85
15	3.65	3.50	3.45	3.00	3.42	3.00	3.25	2.62	2.70	3.00	2.82	2.85
16	3.90	3.50	3.38	3.00	3.05	2.85	3.25	2.58	2.62	3.02	2.83	2.70
17	3.85	3.50	3.40	2.98	2.95	2.78	3.85	2.52	2.62	2.98	2.80	2.85
18	3.90	3.50	3.40	2.98	2.88	2.70	3.32	2.50	2.60	2.95	3.00	2.98
19	5.52	3.50	3.38	3.00	2.90	2.70	3.12	2.48	2.60	2.90	2.92	2.92
20	5.11	3.50	3.32	3.00	3.00	4.38	3.05	2.40	2.60	2.90	3.00	2.95
21	4.70	3.45	3.30	3.10	3.32	4.90	2.98	2.40	2.52	.....	3.10	3.10
22	4.16	3.50	3.28	3.20	3.05	4.88	2.90	2.50	.....	2.98	3.10	3.30
23	4.10	3.45	3.22	3.30	2.90	4.52	2.88	3.25	2.50	2.95	3.20	.....
24	4.30	3.48	3.20	3.52	5.40	3.88	2.80	3.38	2.50	2.98	3.20	.....
25	4.00	3.48	3.18	3.50	6.03	5.65	2.72	3.20	2.50	2.98	.....	3.20
26	4.00	3.45	3.15	3.28	4.75	4.78	2.70	2.95	2.50	3.10	3.10	3.05
27	3.85	3.45	3.12	3.18	3.68	4.10	2.68	2.75	2.50	3.08	3.08	3.02
28	3.75	3.50	3.10	3.15	3.72	4.38	2.68	2.65	2.45	3.00	3.08	3.00
29	3.75	.....	3.10	3.55	4.55	4.45	2.62	2.62	2.45	3.10	2.95	3.05
30	3.90	.....	3.10	3.85	5.45	3.68	2.62	2.52	2.40	3.40	2.95	3.00
31	4.15	.....	3.08	.....	4.90	.....	2.60	2.50	.....	3.40	.....	2.92

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	2.9	3.1	3.25	11	3.25	3.2	3.2	21	3.2	3.6	3.1
2	2.9	3.1	3.25	12	3.2	3.2	.....	22	3.4	.....	3.1
3	2.9	3.1	.....	13	3.2	3.2	3.2	23	3.3	3.3	3.1
4	3.2	3.2	3.25	14	3.2	3.3	.....	24	3.2	3.3	3.1
5	3.9	3.2	3.3	15	3.2	3.35	3.2	25	3.2	3.35	3.3
6	3.95	3.2	3.25	16	3.2	3.35	3.2	26	3.2	3.3	3.5
7	3.75	3.2	.....	17	3.15	3.2	3.15	27	3.2	3.3	3.1
8	3.65	3.2	3.2	18	3.1	3.2	3.15	28	3.2	3.25	3.1
9	3.55	.....	3.2	19	3.1	3.8	3.15	29	3.2	3.25	3.1
10	3.4	3.2	3.2	20	3.1	3.65	3.15	30	3.2	.....	3.5
								31	3.15	.....	.....

Daily discharge, in second-feet, of North Fork of Red River near Headrick, Okla., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	400	770	460	150	1,100	1,500	650	200	150	7,750	620	270
2	360	550	550	150	600	1,200	550	330	150	3,500	580	280
3	360	630	500	140	400	1,000	520	2,300	130	15,500	420	270
4	360	600	500	160	640	850	520	2,600	120	2,500	350	270
5	360	380	450	380	720	830	520	2,100	120	150	400	270
6	360	380	400	920	650	1,000	400	1,070	130	7,800	370	1,160
7	330	480	400	550	1,530	850	370	700	130	4,400	350	620
8	330	590	350	320	750	550	320	600	130	920	300	290
9	1,020	620	440	270	500	13,500	300	550	160	900	200	280
10	2,750	590	400	270	400	9,000	300	400	470	850	200	280
11	770	500	400	260	290	2,700	350	300	1,150	720	210	250
12	700	400	370	250	170	2,000	1,700	270	600	680	210	250
13	620	370	350	240	200	1,000	850	300	370	480	210	230
14	660	350	350	220	200	620	450	200	300	480	250	260
15	400	320	300	210	350	570	350	170	200	480	220	250
16	590	320	250	200	170	520	350	170	180	500	230	180
17	550	320	260	170	150	480	900	160	180	470	200	250
18	590	320	260	140	120	420	450	170	140	450	300	300
19	3,300	320	250	150	130	420	350	170	140	350	250	270
20	2,170	350	230	150	130	1,750	300	150	120	350	300	300
21	1,450	320	220	170	250	3,000	280	150	40	380	360	400
22	830	350	210	210	150	2,900	230	170	60	400	400	530
23	830	320	200	250	100	2,050	220	700	40	380	450	500
24	970	340	190	370	5,500	1,100	200	800	40	370	450	480
25	680	340	180	360	8,100	5,700	180	650	40	370	450	450
26	680	350	170	230	3,200	2,650	170	450	40	450	450	350
27	550	350	170	170	1,120	1,300	180	300	40	430	430	330
28	470	380	150	150	1,110	1,750	180	250	30	370	430	310
29	470	.....	150	340	2,400	1,900	180	230	30	400	350	350
30	590	.....	150	550	5,000	850	180	180	20	620	350	300
31	820	.....	150	.....	3,000	.....	210	180	.....	620	.....	260

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	225	170	240	11	340	195	220	21	240	530	170
2	225	170	235	12	300	193	230	22	330	400	160
3	220	170	230	13	295	195	241	23	260	352	160
4	380	205	225	14	290	240	235	24	225	345	151
5	1,000	205	240	15	280	280	230	25	225	360	240
6	1,050	205	225	16	270	300	220	26	220	325	350
7	820	205	215	17	240	250	200	27	215	310	160
8	710	205	200	18	220	250	200	28	210	280	160
9	580	205	191	19	200	700	200	29	205	260	160
10	460	200	210	20	190	560	200	30	200	.....	350
								31	190	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Fork of Red River near Headrick, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	3,300	330	817	50,200
February	770	320	425	23,600
March	550	150	304	18,700
April	920	140	270	16,100
May	8,100	100	1,260	77,500
June	13,500	420	2,130	127,000
July	1,700	170	410	25,200
August	2,600	150	547	33,600
September	1,150	20	182	10,800
October	15,500	150	1,740	107,000
November	620	200	343	20,400
December	1,160	180	348	21,400
The year	15,500	20	731	532,000
1908.				
January	1,050	190	349	21,500
February	700	170	285	16,400
March 1–30	350	160	215	12,800

NOTE.—Owing to the shifting character of the stream bed at this point, the above values of mean monthly discharge can only be classed in general as fair (C) and some months are only approximate (D).

ELM FORK OF RED RIVER NEAR MANGUM, OKLA.

This station, which was established April 12, 1905, to determine the amount of flood waters available for storage in the proposed Navajo reservoir (Red River project), of the United States Reclamation Service, was abandoned March 31, 1908. It was located on the highway bridge about 4 miles north of Mangum, Okla., which is some 10 miles above the mouth of the stream.

The datum of the gage remained unchanged during the maintenance of the station. As the stream bed shifts frequent discharge measurements were necessary. The pile bents of the bridge interfere considerably with the accuracy of the results.

Discharge measurements of Elm Fork of Red River near Mangum, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 10	W. A. Lamb	115	172	3.27	209
March 11	do	115	92	3.00	128
April 10	Lamb and Cooper	85	62	2.75	70
April 16	R. L. Cooper	102	64	2.75	63
April 20	do	120	71	2.76	70
April 24	do	120	69	2.80	69
April 27	do	110	68	2.72	66
May 2	do	160	115	2.90	125
May 7	do	191	241	3.37	321
May 23	do	165	75	2.70	81
May 29	do	221	391	3.90	613
June 4	do	190	128	3.05	157
June 19	Lamb and Cooper	172	496	4.52	1,150
June 26	do	235	214	3.45	331
July 6	R. L. Cooper	215	106	3.10	139
July 11	do	235	208	3.50	355
July 18	do	140	81	2.95	106
July 23	do	118	69	2.90	95
July 26	do	100	53	2.85	62
July 30	do	118	69	2.86	77
August 3	do	265	446	4.20	772
August 8	do	100	59	2.95	88
August 14	do	100	50	2.83	60
August 16	do	100	42	2.80	44
August 24	do	110	51	2.90	67
August 28	do	100	46	2.80	48
August 31	do	100	47	2.80	46
September 7	do	105	29	2.75	31
September 24	do	98	35	2.70	30
September 27	do	98	35	2.70	29
October 6	do	175	167	3.40	386
October 10	do	189	124	3.10	233
October 15	do	189	92	2.95	138
October 18	do	188	82	2.92	102
October 22	do	188	79	2.95	113
October 25	do	188	81	2.95	119
October 30	do	188	148	3.20	260
November 4	do	188	84	2.90	117
November 9	do	148	62	2.80	85
December 6	do	134	60	.....	73
December 14	do	157	64	2.72	72
December 27	do	130	87	2.80	76
1908.					
January 9	R. L. Cooper	158	82	2.85	110
January 18	do	119	70	2.76	85
January 24	do	118	66	2.75	76
January 29	do	118	70	2.75	88
February 4	do	118	69	2.80	89
February 8	do	118	66	2.70	85
February 17	do	177	119	3.00	171
February 26	do	123	80	2.80	98
March 6	do	108	63	2.65	80
March 12	do	103	59	2.65	76
March 21	do	81	40	2.55	38

27586—IRR 247—10——7

Daily gage height, in feet, of Elm Fork of Red River near Mangum, Okla., for 1907 and 1908.

[E. R. Pierson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.1	3.3	3.0	2.8	3.2	3.3	3.2	2.9	2.6	6.6	3.0	2.7
2	3.1	3.3	3.0	2.8	3.2	3.2	3.1	4.25	2.6	4.6	3.0	2.7
3	3.1	3.3	2.9	2.8	3.9	3.1	3.1	4.3	2.6	12.3	2.9	2.7
4	3.1	3.3	2.9	2.8	3.5	3.1	3.1	3.7	2.9	6.6	2.8	2.7
5	3.1	3.4	2.9	3.0	3.5	3.2	3.1	3.1	2.9	3.1	2.8	2.7
6	3.1	3.3	2.9	3.0	5.3	3.3	3.1	3.0	2.7	3.1	2.8	2.7
7	3.1	3.3	2.9	2.9	3.3	3.1	3.1	3.1	2.7	3.2	2.8	2.7
8	3.1	3.3	2.9	2.9	3.1	3.1	3.1	3.1	2.7	3.2	2.8	2.7
9	4.1	3.3	3.0	2.8	3.0	10.1	3.1	2.9	2.6	2.4	2.7	2.7
10	4.5	3.3	3.0	2.8	2.9	6.6	3.1	2.8	2.9	2.4	2.7	2.7
11	3.1	3.3	3.0	2.8	2.9	3.2	3.5	2.8	2.8	2.3	2.7	2.7
12	3.5	3.3	3.0	2.7	2.8	3.5	3.2	2.8	2.9	3.0	2.7	2.7
13	3.3	3.2	3.0	2.7	2.8	3.2	3.1	2.8	2.8	3.0	2.7	2.7
14	3.3	3.1	3.0	2.7	2.8	3.2	3.1	2.8	2.8	2.9	2.7	2.7
15	3.3	3.1	3.0	2.7	2.8	3.2	3.1	2.8	2.8	2.9	2.7	2.7
16	3.3	3.1	3.9	2.7	2.8	3.0	3.0	2.8	2.7	2.9	2.7	2.7
17	3.3	3.1	2.9	2.7	2.7	3.9	2.9	2.8	2.7	2.9	2.7	2.7
18	3.3	3.1	2.9	2.7	2.7	3.3	2.9	2.8	2.8	2.9	2.7	2.7
19	8.7	3.1	2.9	2.7	2.7	3.2	2.9	2.7	2.9	2.9	2.7	2.7
20	3.8	3.0	3.9	2.6	2.7	3.2	2.9	3.1	2.7	2.9	2.9	2.7
21	3.6	3.0	3.9	2.7	2.7	6.3	2.9	3.2	2.7	2.9	2.9	5.0
22	5.4	3.0	2.8	2.8	2.7	3.9	2.8	3.1	2.7	2.9	2.9	4.0
23	3.5	3.0	2.8	2.8	2.7	3.7	2.8	3.1	2.7	2.9	2.9	3.3
24	3.5	3.0	2.8	2.8	8.0	3.2	2.9	2.9	2.7	2.9	2.8	3.0
25	3.5	3.0	2.8	2.8	4.0	4.2	2.8	3.0	2.7	2.9	2.8	3.3
26	3.5	3.0	2.8	2.7	3.3	3.4	2.8	2.8	2.7	2.9	2.8	2.8
27	3.4	3.0	2.8	2.6	3.0	3.2	2.8	2.9	2.7	2.9	2.8	2.7
28	3.4	3.0	2.8	2.6	3.1	4.0	2.8	2.9	2.9	2.9	2.7	2.7
29	3.3	.....	2.8	3.1	3.7	3.4	2.8	2.8	2.8	2.9	2.7	2.7
30	3.4	.....	2.8	4.5	3.6	3.2	2.8	2.8	2.7	3.0	2.7	2.7
31	3.4	.....	2.8	.....	3.3	.....	2.8	2.8	.....	3.0	.....	2.7

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	2.7	2.7	2.7	11	2.8	2.7	2.7	21	2.8	2.8	2.5
2	2.7	3.2	2.6	12	2.7	2.7	2.7	22	2.7	2.8	2.5
3	2.8	2.7	2.6	13	2.7	2.7	2.6	23	2.7	2.8	2.5
4	3.0	2.7	2.6	14	2.7	2.7	2.6	24	2.7	2.8	2.5
5	3.3	2.7	2.6	15	2.7	2.7	2.6	25	2.7	2.8	2.5
6	3.0	2.8	2.6	16	2.7	2.8	2.6	26	2.7	2.8	2.5
7	2.8	2.8	2.7	17	2.7	3.0	2.6	27	2.7	2.8	2.5
8	2.8	2.8	2.6	18	2.8	3.1	2.6	28	2.7	2.8	2.5
9	2.7	2.9	2.6	19	2.8	3.0	2.5	29	2.7	2.7	2.5
10	2.7	2.7	2.7	20	2.8	2.8	2.5	30	2.7	.....	2.5
								31	2.7	.....	2.5

Daily discharge, in second-feet, of Elm Fork of Red River near Mangum, Okla., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	128	210	125	80	230	280	180	80	20	3,600	140	70
2	128	210	125	80	235	220	140	760	20	1,350	140	70
3	128	210	95	80	610	180	140	860	20	15,800	120	70
4	128	210	95	80	380	175	140	410	70	3,600	90	70
5	128	265	95	138	380	215	140	150	70	250	90	70
6	128	220	95	138	1,830	257	139	110	30	250	90	70
7	128	220	95	107	290	180	160	140	30	300	90	70
8	128	220	100	110	205	180	160	130	30	300	90	70
9	600	220	128	83	165	10,700	170	80	20	40	70	70
10	920	220	128	83	132	3,600	170	60	70	40	70	70
11	128	220	128	82	132	217	355	60	40	20	70	70
12	285	220	128	58	103	350	220	60	70	180	70	70
13	205	185	128	56	103	217	190	60	40	180	70	70
14	205	150	128	55	103	217	190	60	40	120	70	70
15	205	150	128	54	103	217	170	44	40	120	70	70
16	205	150	540	52	106	143	130	44	30	120	70	70
17	205	150	100	54	81	610	100	44	30	100	70	70
18	205	150	100	55	81	260	100	44	50	100	70	70
19	7,600	150	100	57	81	217	100	20	70	100	70	70
20	440	120	540	40	81	217	100	120	30	100	120	70
21	340	120	540	57	81	3,150	100	140	30	100	120	1,600
22	1,930	125	77	76	81	580	70	120	30	100	120	640
23	295	125	77	72	81	450	70	120	30	100	120	250
24	295	125	78	69	6,200	217	80	67	30	100	90	140
25	300	125	78	75	700	850	60	90	30	100	90	250
26	300	125	78	58	290	310	60	48	30	100	90	80
27	255	125	78	44	160	215	60	68	29	100	90	60
28	255	125	78	45	200	680	60	68	70	100	70	60
29	210	.....	78	185	475	295	60	48	50	100	70	60
30	255	.....	78	1,130	420	200	60	47	30	130	70	60
31	255	.....	78	.....	280	.....	60	46	.....	130	.....	60

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	66	70	81	11	96	85	88	21	90	103	31
2	66	230	61	12	71	80	88	22	68	103	30
3	90	68	62	13	71	80	62	23	66	102	30
4	150	66	64	14	71	80	61	24	65	101	30
5	275	70	67	15	71	80	60	25	65	100	30
6	155	98	68	16	71	106	58	26	68	98	30
7	94	105	93	17	71	171	55	27	71	100	30
8	95	112	68	18	95	207	54	28	73	103	30
9	72	134	68	19	95	170	35	29	75	78	30
10	72	85	90	20	93	105	33	30	75	.....	30
								31	73	.....	30

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Elm Fork of Red River near Mangum, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	7,600	128	546	33,600
February	265	120	173	9,610
March	540	77	143	8,790
April	1,130	40	112	6,660
May	6,200	81	464	28,500
June	10,700	143	853	50,800
July	355	60	127	7,810
August	860	20	135	8,300
September	70	20	39.3	2,340
October	15,800	20	898	55,200
November	140	70	89.0	5,300
December	1,600	60	150	9,220
The year	15,800	20	311	226,000
1908.				
January	275	65	88.0	5,410
February	230	66	107	6,160
March	93	30	53.1	3,260

NOTE.—Conditions of flow are very changeable at low stages at this station. They are not, however, so poor as at many other points in this drainage and owing to the numerous measurements made the above results are in general classed as good (B) although some months may be no better than fair (C).

ELK CREEK NEAR HOBART, OKLA.

This station, which was established September 22, 1904, to obtain data for use in connection with the Red River project of the United States Reclamation Service, was abandoned March 31, 1908. The original station was located 3 miles southwest of Hobart and was moved on April 13, 1905, to a highway bridge about 7 miles south of Hobart and some 20 miles above the mouth of the stream.

Elk Creek enters the north fork of the Red a few miles above the proposed Navajo reservoir.

The gage datum was not changed after April 13, 1905. The published gage heights from January 1 to April 13, 1905, were made to refer to this datum by adding 0.40 feet to the readings taken at the old gage, 4 or 5 miles upstream.

The stream bed shifts somewhat, but very good results were obtained except during high water, when the left bank is overflowed.

Discharge measurements of Elk Creek near Hobart, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 9	W. A. Lamb	20	47	3.95	92
March 11	do	19	35	3.43	60
April 9	Lamb and Cooper	21	33	3.26	62
May 24	R. L. Cooper	218	1,670	23.57	3,070
June 6	do	18	87	5.74	181
June 17	do	20.9	67	5.70	132
Do	W. A. Lamb	24	77	5.70	150
July 14	R. L. Cooper	20	45	4.10	58
August 5	do	21	57	4.45	80
August 21	do	15.3	20	2.98	14
September 4	do	15.7	18	2.65	15
September 28	do	17	17	2.50	16
October 7	do	26.2	132	7.40	286
October 11	do	20.9	69	5.10	115
October 17	do	19.2	54	4.40	84
October 31	do	21	67	5.00	109
November 3	do	20.1	47	4.20	60
November 23	do	20.1	46	4.10	56
December 8	do	19.2	35	3.70	37
December 22	do	21	58	4.60	74
1908.					
January 4	R. L. Cooper	21	48	4.20	53
January 14	do	22	50	4.30	66
January 25	do	21	46	4.00	57
February 6	do	20	42	4.00	56
February 13	do	20	46	3.95	55
March 7	do	20	42	4.00	56
March 14	do	20	41	4.00	54

Daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1907 and 1908.

[Andrew Hines, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.5	4.5	3.5	2.9	5.3	5.3	7.0	3.4	2.7	2.4	4.2	3.7
2	3.5	4.5	3.4	2.9	5.8	5.4	7.0	3.7	2.7	6.4	4.1	3.7
3	3.5	4.0	3.4	2.9	4.3	5.3	6.1	4.3	2.7	15.1	4.1	3.6
4	3.5	4.0	3.4	2.9	3.9	6.1	6.0	6.0	2.6	17.0	4.1	3.6
5	3.5	4.0	3.4	3.4	3.7	6.2	6.0	4.1	2.6	18.9	4.0	3.6
6	3.5	3.9	3.4	8.1	3.7	5.1	6.0	3.8	2.6	16.1	4.0	3.6
7	3.5	3.9	3.4	4.5	3.6	4.1	4.7	3.5	2.6	10.2	4.0	3.6
8	3.5	3.9	3.4	3.1	3.6	4.0	4.6	3.3	3.8	6.7	4.0	3.7
9	3.9	3.9	3.8	3.1	3.6	28.9	4.6	3.3	5.0	5.8	4.0	3.7
10	6.8	3.9	3.5	3.1	3.4	22.6	4.5	3.3	5.9	5.3	4.0	3.7
11	6.2	3.8	3.5	3.0	3.4	16.4	4.4	3.1	7.5	5.3	3.9	3.6
12	5.3	3.8	3.4	3.0	3.0	6.2	4.3	3.1	5.0	5.0	3.9	3.6
13	4.3	3.8	3.3	2.9	3.0	6.0	4.3	3.0	3.0	4.8	3.8	3.6
14	4.0	3.8	3.1	2.9	5.0	6.0	4.1	3.0	3.0	4.4	3.7	3.6
15	4.0	3.8	3.1	2.9	4.1	5.5	4.0	3.0	3.0	4.3	3.7	3.6
16	4.0	3.8	3.1	2.9	3.3	5.5	3.9	2.9	2.9	4.3	3.7	3.6
17	4.0	3.7	3.1	2.9	3.3	5.5	3.7	2.9	2.9	4.2	3.9	3.6
18	4.0	3.7	3.0	2.9	3.3	5.5	3.7	2.8	2.9	4.2	3.9	3.6
19	9.3	3.7	3.0	2.9	3.2	5.5	3.7	2.9	2.8	4.2	3.9	3.6
20	12.2	3.7	3.0	3.0	3.2	5.5	3.7	5.9	2.7	4.2	4.1	3.6
21	9.3	3.7	3.0	3.1	3.3	5.5	3.7	4.3	2.6	4.2	4.1	3.6
22	6.3	3.7	3.0	3.2	3.3	9.1	3.6	3.3	2.6	4.2	4.1	4.8
23	5.2	3.7	3.0	3.2	3.3	10.5	3.6	3.0	2.6	4.2	4.1	7.0
24	5.0	3.6	3.0	3.3	23.0	6.1	3.6	3.0	2.6	4.2	4.2	5.1
25	4.4	3.5	3.0	3.4	22.0	10.1	3.5	2.9	2.6	4.3	4.1	4.9
26	4.4	3.5	3.0	3.4	15.3	5.6	3.5	2.9	2.6	4.3	4.0	4.9
27	4.4	3.5	3.0	3.4	5.9	5.5	3.5	2.9	2.6	4.3	3.9	4.0
28	4.5	3.5	3.0	3.4	4.3	6.1	3.4	2.9	2.6	4.8	3.8	4.0
29	4.5	.....	3.0	3.9	6.3	6.0	3.4	2.8	2.6	5.8	3.8	4.0
30	4.5	.....	3.0	4.3	6.0	7.0	3.4	2.8	2.4	5.0	3.8	4.0
31	4.5	.....	3.0	.....	5.3	.....	3.4	2.8	.....	4.7	.....	4.0

Daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	4.0	3.9	4.1	11	5.0	3.8	4.0	21	4.1	4.8	3.8
2	4.0	3.9	4.1	12	4.8	3.9	4.0	22	4.1	4.6	3.9
3	4.3	3.9	4.1	13	4.8	3.9	4.0	23	4.0	4.5	3.9
4	5.1	3.9	4.0	14	4.6	3.9	3.9	24	4.0	4.5	3.9
5	6.8	3.9	4.0	15	4.2	3.9	3.9	25	4.0	4.5	3.9
6	6.1	3.9	4.0	16	4.2	4.8	3.8	26	4.0	4.6	3.9
7	5.8	3.9	4.0	17	4.2	5.1	3.8	27	4.0	4.6	3.8
8	5.4	3.8	4.0	18	4.2	5.0	3.8	28	4.0	4.4	3.8
9	5.0	3.9	4.0	19	4.2	4.8	3.8	29	3.9	4.3	3.6
10	5.0	3.8	4.0	20	4.2	4.8	3.8	30	3.9	.....	3.6
								31	3.9	.....	3.6

Daily discharge, in second-feet, of Elk Creek near Hobart, Okla., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	70	130	70	45	185	150	240	30	15	15	65	40
2	70	130	60	45	225	160	240	40	15	200	60	40
3	70	100	60	45	120	150	180	70	15	1,170	55	35
4	70	100	60	45	95	210	170	170	15	1,480	55	35
5	70	100	60	70	85	220	170	60	15	1,870	50	35
6	70	90	60	339	85	140	170	45	15	1,330	50	35
7	70	90	60	130	80	80	90	30	15	542	50	35
8	70	90	60	55	80	70	80	25	65	230	50	40
9	90	90	80	55	80	5,000	80	25	130	160	50	40
10	300	90	60	55	70	2,820	80	25	200	130	50	40
11	250	85	60	50	70	1,380	70	20	290	130	45	35
12	180	85	60	50	50	180	70	20	130	110	45	35
13	115	85	50	45	50	160	70	15	30	100	40	35
14	100	85	40	45	165	160	60	15	30	80	40	35
15	100	85	40	45	110	130	50	15	30	80	40	35
16	100	85	40	45	65	130	50	10	30	80	40	30
17	100	80	40	45	65	130	40	10	30	70	45	30
18	100	80	40	45	65	130	40	8	30	70	45	30
19	450	80	40	45	60	130	40	10	25	70	45	30
20	764	80	40	50	60	130	40	160	20	70	55	30
21	450	80	40	55	65	130	40	70	20	70	55	30
22	260	80	40	60	65	430	40	25	20	70	55	80
23	170	80	40	60	65	575	40	15	20	70	55	230
24	160	70	40	65	2,930	180	40	15	20	70	60	100
25	120	70	45	70	2,660	531	30	15	20	75	55	90
26	120	70	45	70	1,200	140	30	15	20	75	50	90
27	120	70	45	70	190	140	30	15	20	75	45	45
28	130	70	45	70	90	180	30	15	20	100	40	45
29	130	.....	45	95	220	170	30	15	20	160	40	45
30	130	.....	45	120	200	250	30	15	15	110	40	45
31	130	.....	45	.....	150	.....	30	15	.....	90	.....	45

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	45	52	61	11	100	48	55	21	60	99	45
2	45	52	61	12	90	53	54	22	60	87	49
3	58	52	61	13	91	53	54	23	55	82	49
4	99	52	56	14	81	53	49	24	56	82	49
5	215	52	56	15	62	53	49	25	57	82	49
6	165	52	56	16	62	99	45	26	57	87	49
7	145	52	56	17	63	117	45	27	57	87	45
8	129	47	56	18	63	110	45	28	57	76	45
9	98	53	56	19	63	99	45	29	52	71	37
10	99	48	55	20	64	99	45	30	52	.....	37
								31	52	.....	37

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Elk Creek near Hobart, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	764	70	165	10,100
February	130	70	86.8	4,820
March	80	40	50.2	3,090
April	339	45	69.5	4,140
May	2,930	50	313	19,200
June	5,000	70	480	28,600
July	240	30	77.4	4,760
August	170	8	33.3	2,050
September	290	15	44.7	2,660
October	1,870	15	289	17,800
November	65	40	49.0	2,920
December	230	30	49.8	3,060
The year	5,000	8	142	103,000
1908.				
January	215	45	78.8	4,850
February	117	47	70.7	4,070
March	61	37	50.0	3,070

NOTE.—Although conditions of flow at this station are quite changeable, it is believed that the above results can in general be classed as good (B).

OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station, which was established April 2, 1903, to obtain data for use in connection with the proposed Otter Creek project of the United States Reclamation Service, from which 10,000 acres of land were to be irrigated, was abandoned March 31, 1908. It was located on G. M. Dale's homestead in the SE. $\frac{1}{4}$ sec. 21, T. 3 N., R. 17 W. of the Indian meridian, and is 2 miles west and 1 mile north of Mountain Park, Okla.

The station is several miles above the mouth of Horse Creek and Dry Otter Creek. The main stream as well as the two tributaries mentioned above may properly be classed as intermittent. The Mountain Park reservoir site, some 2 miles north of Snyder, has a capacity of about 45,000 acre-feet with a dam 50 feet high. Horse Creek and Dry Otter Creek as well as Elk Creek could be diverted into this reservoir, but the expense would be prohibitive.

The datum of the gage was not changed during the continuance of the station.

The water flows in one channel at normal stages, but at times of flood part of it is diverted above the station into a slough which discharges into Horse Creek.

The bed of the stream shifts somewhat but not so much so as at most of the other stations in this region. By taking occasional discharge measurements fair results can be obtained.

Discharge measurements of Otter Creek near Mountain Park, Okla., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 7	W. A. Lamb	17	12	1.50	15
March 9	do	34	78	3.65	164
April 8	Lamb and Cooper	18	11	1.40	12
April 30	R. L. Cooper	32	115	4.66	259
May 5	do	41	220	6.80	549
June 16	W. A. Lamb	32	31	2.20	50
August 29	R. L Cooper	12	2.4	1.20	1.7
September 9	do	28	59	3.30	124
October 16	do	18	4.4	1.20	2.8

Daily gage height, in feet, of Otter Creek near Mountain Park, Okla., for 1907 and 1908.

[G. M. Dale, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.5	1.6	1.5	1.4	2.4	2.9	1.7	1.3	1.2	1.1	1.3	1.3
2	1.5	1.6	1.5	1.4	1.8	2.4	1.7	1.4	1.2	1.1	1.3	1.3
3	1.5	1.6	1.5	1.4	3.8	2.1	1.7	1.5	1.2	1.2	1.3	1.3
4	1.5	1.5	1.5	1.4	3.1	2.0	1.6	1.4	1.2	1.6	1.3	1.3
5	1.5	1.8	1.4	1.7	6.2	1.9	1.6	1.4	1.2	1.4	1.2	1.3
6	1.5	1.6	1.4	1.5	4.1	4.15	1.6	1.4	1.2	1.3	1.2	1.3
7	1.5	1.6	1.4	1.5	3.1	2.5	1.6	1.3	1.2	1.2	1.2	1.3
8	1.5	1.5	1.4	1.4	2.2	2.0	1.6	1.3	1.2	1.2	1.2	1.3
9	4.55	1.5	3.6	1.4	1.9	18.75	1.5	1.3	2.6	1.2	1.2	1.3
10	4.6	1.5	2.3	1.4	1.7	17.1	1.5	1.3	1.4	1.2	1.2	1.3
11	2.8	1.5	1.9	1.3	1.6	4.0	1.5	1.3	1.3	1.2	1.2	1.3
12	2.3	1.5	1.7	1.3	1.5	6.6	1.5	1.3	1.3	1.2	1.2	1.3
13	2.0	1.5	1.6	1.3	1.5	3.0	1.5	1.3	1.2	1.2	1.2	1.4
14	1.9	1.5	1.6	1.3	6.45	2.6	1.5	1.3	1.2	1.2	1.2	1.4
15	1.8	1.5	1.5	1.3	2.8	2.4	1.5	1.2	1.2	1.2	1.2	1.4
16	1.7	1.5	1.5	1.3	2.0	2.2	1.5	1.2	1.2	1.2	1.2	1.4
17	1.7	1.5	1.5	1.3	1.7	2.1	1.5	1.2	1.2	1.2	1.2	1.4
18	1.7	1.5	1.5	1.3	1.6	2.0	1.4	1.2	1.2	1.2	1.2	1.4
19	2.3	1.5	1.4	1.3	1.5	2.0	1.4	1.2	1.2	1.2	1.3	1.4
20	3.1	1.5	1.4	1.3	1.4	2.0	1.4	1.2	1.2	1.2	1.4	1.4
21	2.3	1.5	1.4	1.4	1.4	2.0	1.4	1.2	1.2	1.2	1.4	1.9
22	2.0	1.5	1.4	1.4	1.4	2.0	1.4	1.2	1.2	1.2	1.4	1.9
23	1.8	1.5	1.4	1.4	1.4	2.0	1.4	1.3	1.2	1.2	1.3	1.7
24	1.8	1.5	1.4	1.4	6.8	1.9	1.4	1.3	1.1	1.2	1.3	1.6
25	1.8	1.5	1.4	1.3	8.4	1.9	1.4	1.3	1.1	1.3	1.3	1.5
26	1.7	1.5	1.4	1.3	3.0	1.8	1.4	1.2	1.1	1.3	1.3	1.4
27	1.7	1.5	1.4	1.3	2.2	1.8	1.4	1.2	1.1	1.3	1.3	1.4
28	1.7	1.6	1.4	1.3	5.5	1.8	1.4	1.2	1.1	1.3	1.3	1.4
29	1.7	.....	1.4	3.75	7.55	1.8	1.4	1.2	1.1	2.3	1.3	1.4
30	1.7	.....	1.4	4.8	11.7	1.7	1.3	1.2	1.1	1.6	1.3	1.4
31	1.6	.....	1.4	.....	4.5	.....	1.3	1.2	.....	1.4	.....	1.4

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	1.3	1.3	1.3	11	1.3	1.3	1.3	21	1.3	1.3	1.3
2	1.4	1.3	1.3	12	1.3	1.3	1.3	22	1.3	1.3	1.3
3	1.5	1.3	1.3	13	1.3	1.3	1.3	23	1.3	1.3	1.3
4	2.1	1.3	1.3	14	1.3	1.3	1.3	24	1.3	1.3	1.3
5	1.9	1.3	1.3	15	1.3	1.3	1.3	25	1.3	1.5	1.3
6	1.6	1.3	1.3	16	1.3	1.3	1.3	26	1.3	1.4	1.3
7	1.5	1.3	1.3	17	1.3	1.3	1.3	27	1.3	1.4	1.3
8	1.4	1.3	1.3	18	1.3	1.3	1.3	28	1.3	1.3	1.3
9	1.4	1.3	1.3	19	1.3	1.3	1.3	29	1.3	1.3	1.3
10	1.3	1.3	1.3	20	1.3	1.3	1.3	30	1.3	.....	1.3
								31	1.3	.....	1.3

Rating table for Otter Creek near Mountain Park, Okla., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	0	2.80	91	4.50	240	7.20	616
1.20	2	2.90	98	4.60	251	7.40	652
1.30	6	3.00	105	4.70	262	7.60	688
1.40	10	3.10	113	4.80	273	7.80	724
1.50	15	3.20	121	4.90	284	8.00	760
1.60	20	3.30	129	5.00	295	9.00	950
1.70	25	3.40	137	5.20	319	10.00	1,140
1.80	30	3.50	145	5.40	343	11.00	1,330
1.90	35	3.60	154	5.60	369	12.00	1,520
2.00	40	3.70	163	5.80	397	13.00	1,710
2.10	46	3.80	172	6.00	425	14.00	1,900
2.20	52	3.90	181	6.20	455	15.00	2,100
2.30	58	4.00	190	6.40	485	16.00	2,300
2.40	64	4.10	200	6.60	516	17.00	2,500
2.50	70	4.20	210	6.80	548	18.00	2,700
2.60	77	4.30	220	7.00	580	19.00	2,900
2.70	84	4.40	230				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907 and two high-water measurements of 1905, and is well defined between gage heights 1.4 feet and 6.8 feet.

Monthly discharge of Otter Creek near Mountain Park, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	251	15	46.8	2,880	B.
February	30	15	16.6	922	C.
March	154	10	19.4	1,190	C.
April	273	6	23.0	1,370	C.
May	1,460	10	20.3	12,500	A.
June	2,850	25	249	14,800	A.
July	25	6	14.3	879	C.
August	15	2	5.0	307	D.
September	77	0	4.6	274	D.
October	58	0	6.0	369	D.
November	10	2	4.5	268	D.
December	35	6	11.0	676	D.
The year	2,850	0	50.3	36,400	
1908.					
January	46	6	9.6	590	D.
February	15	6	6.6	380	D.
March	6	6	6.0	369	D.

WASHITA RIVER AT ANADARKO, OKLA.

This station, which was established April 25, 1902, at the request of the United States Reclamation Service, in order to determine the amount of water available for irrigation, was located at the highway bridge one-half mile north of the Anadarko railroad depot. Gage readings were discontinued on June 30, 1908. No important tributaries enter above or below the station for several miles.

No change was made in the datum of the gage during the continuance of the station. The river channel shifts considerably during floods, but as it is comparatively stable at other times good results should be obtained by taking occasional discharge measurements. Ice sometimes affects the flow of the stream for short periods in the winter season.

Discharge measurements of Washita River at Anadarko, Okla., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 11	W. A. Lamb	70	241	4.38	447
April 12	do	64	216	3.80	347
December 5	R. L. Cooper	68	213	3.70	291
1908.					
January 27	R. L. Cooper	70	217	3.90	319

Daily gage height, in feet, of Washita River at Anadarko, Okla., for 1907 and 1908.

[James H. Dunlop and Jack Mahseet, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	5.0	3.8	3.4	6.9	13.6	13.8	5.2	3.55	2.8	5.1	3.8
2	3.55	4.9	3.8	3.4	7.9	12.9	14.0	5.2	3.4	2.8	4.7	3.8
3	3.55	4.8	3.8	3.4	7.1	8.9	14.3	5.0	3.4	2.85	4.4	3.75
4	3.6	4.7	3.9	3.4	5.5	6.3	12.2	4.7	3.4	6.4	4.2	3.75
5	3.5	4.6	3.85	3.4	4.9	5.8	9.3	4.8	3.4	20.1	4.15	3.7
6	3.5	4.5	3.8	3.4	5.6	5.7	8.1	5.1	3.4	21.7	4.1	3.7
7	3.5	4.4	3.75	3.7	6.7	5.9	7.0	5.15	3.4	22.4	4.1	3.7
8	3.5	4.4	3.7	3.9	9.6	6.6	7.3	5.5	3.4	22.55	4.0	3.7
9	3.5	4.4	4.0	3.7	8.1	6.4	7.5	5.3	3.45	22.8	4.0	3.7
10	3.7	4.5	3.9	4.3	5.5	12.3	7.7	5.1	3.5	22.3	3.95	3.65
11	5.0	4.5	4.0	3.9	4.9	16.2	6.8	5.1	3.5	7.55	3.9	3.65
12	5.5	4.35	4.2	3.7	4.5	18.2	6.5	5.0	3.5	6.4	3.85	3.65
13	6.4	4.3	4.0	3.6	4.3	19.1	6.3	4.9	3.4	5.9	3.8	3.65
14	6.0	4.3	3.8	3.6	4.6	20.5	6.2	4.9	3.45	5.4	3.8	3.65
15	5.4	4.2	3.8	3.5	6.3	20.4	6.2	4.7	3.35	5.3	3.8	3.65
16	4.85	4.2	3.7	3.4	12.6	18.6	6.0	4.7	3.2	5.15	3.8	3.65
17	4.7	4.1	3.65	3.4	13.4	10.0	6.0	3.9	3.1	5.0	3.8	3.65
18	4.55	4.1	3.6	3.4	6.2	8.8	5.9	3.9	3.05	4.9	3.8	3.65
19	4.55	4.0	3.6	3.3	5.0	8.1	5.7	3.8	3.05	4.7	3.8	3.65
20	4.6	4.0	3.55	3.3	4.8	7.9	5.4	3.8	3.0	4.7	3.9	3.6
21	5.4	3.95	3.55	3.3	4.4	8.2	5.4	3.7	3.0	4.8	3.95	3.6
22	10.3	3.9	3.5	3.3	5.0	8.0	5.3	3.7	3.0	4.85	4.05	3.9
23	11.25	3.9	3.5	3.4	4.2	10.3	5.2	3.7	2.95	4.6	4.1	4.7
24	9.75	3.9	3.5	3.4	4.4	14.1	5.2	3.6	2.95	4.5	4.1	5.15
25	6.8	3.85	3.45	3.4	7.5	14.9	5.0	3.6	2.9	4.45	4.1	5.5
26	6.2	3.8	3.45	3.4	13.4	14.3	5.0	3.6	2.9	4.4	4.0	5.95
27	5.8	3.8	3.4	3.5	15.2	14.2	5.0	3.6	2.85	4.35	3.95	5.0
28	5.55	3.75	3.4	3.5	14.2	14.1	5.0	3.5	2.85	4.3	3.9	4.7
29	5.4	.....	3.4	3.5	6.7	12.9	5.0	3.5	2.8	4.5	3.85	4.6
30	5.2	.....	3.4	3.9	9.3	13.1	5.0	3.55	2.8	4.6	3.8	4.4
31	5.1	.....	3.4	.....	11.7	.....	5.0	3.55	.....	5.2	.....	4.2

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1908.							1908.						
1	4.1	3.85	4.15	3.7	4.6	15.4	16	4.1	3.9	3.9	5.5	4.3	20.95
2	4.1	3.75	4.1	3.7	4.5	10.15	17	4.1	4.0	3.9	5.3	4.2	20.85
3	4.1	3.75	4.5	3.7	4.55	10.55	18	4.0	4.35	3.95	5.4	4.2	21.55
4	4.1	3.75	3.95	3.7	4.55	10.7	19	4.0	4.5	3.9	5.1	4.1	21.45
5	4.5	3.75	3.95	3.75	4.4	13.15	20	3.95	4.6	3.9	4.8	4.0	21.0
6	4.8	3.75	3.95	3.9	4.4	13.0	21	3.95	4.65	3.9	6.7	3.95	20.7
7	5.5	3.75	3.95	3.9	4.3	11.7	22	3.95	4.5	3.8	6.0	3.8	20.4
8	5.2	3.75	3.85	3.85	7.1	13.15	23	3.95	4.4	3.8	5.8	6.7	20.1
9	5.0	3.75	3.85	4.05	8.3	17.6	24	3.95	4.35	3.75	5.85	14.85	19.7
10	4.9	3.75	3.85	4.4	5.5	19.4	25	3.95	4.35	3.75	7.1	17.5	18.1
11	4.7	3.75	3.85	6.0	5.1	21.7	26	3.95	4.3	3.75	5.6	18.5	16.0
12	4.4	3.75	3.85	9.1	5.0	21.45	27	3.95	4.2	3.75	5.1	20.75	12.95
13	4.4	3.75	3.85	7.6	4.85	21.1	28	3.95	4.15	3.7	4.9	20.8	12.1
14	4.3	3.85	3.85	6.0	4.6	20.9	29	3.9	4.15	3.7	4.8	20.5	11.6
15	4.2	3.85	3.9	5.7	4.4	21.0	30	3.9	.....	3.7	4.7	19.8	11.45
							31	3.9	.....	3.7	.....	18.6	.....

Rating tables for Washita River at Anadarko, Okla.

FOR 1906 AND 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	158	4.40	432	6.00	725	9.00	1,510
2.90	174	4.50	450	6.20	765	10.00	1,880
3.00	190	4.60	468	6.40	805	11.00	2,280
3.10	207	4.70	486	6.60	846	12.00	2,700
3.20	224	4.80	504	6.80	888	13.00	3,150
3.30	241	4.90	522	7.00	930	14.00	3,600
3.40	258	5.00	540	7.20	975	15.00	4,050
3.50	275	5.10	558	7.40	1,024	16.00	4,500
3.60	292	5.20	576	7.60	1,077	17.00	5,000
3.70	309	5.30	594	7.80	1,132	18.00	5,500
3.80	326	5.40	612	8.00	1,190	19.00	6,000
3.90	343	5.50	630	8.20	1,251	20.00	6,500
4.00	360	5.60	649	8.40	1,313	21.00	7,000
4.10	378	5.70	668	8.60	1,377	22.00	7,500
4.20	396	5.80	687	8.80	1,443	23.00	8,000
4.30	414	5.90	706				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906 and 1907, and is fairly well defined below gage height 15.0 feet.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.70	285	4.60	444	5.50	612	6.40	798
3.80	302	4.70	462	5.60	632	6.50	820
3.90	319	4.80	480	5.70	652	6.60	842
4.00	336	4.90	498	5.80	672	6.70	864
4.10	354	5.00	516	5.90	692	6.80	886
4.20	372	5.10	535	6.00	713	6.90	908
4.30	390	5.20	554	6.10	734	7.00	930
4.40	408	5.30	573	6.20	755		
4.50	426	5.40	592	6.30	776		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906–1908 and is fairly well defined below gage height 15.0 feet. Above gage height 7.0 feet use 1907 table.

Monthly discharge of Washita River at Anadarko, Okla., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	2,380	275	646	39,700	B.
February	540	318	406	22,500	B.
March	396	258	306	18,800	C.
April	414	241	279	16,600	C.
May	4,140	396	1,260	77,500	B.
June	6,750	668	2,870	171,000	B.
July	3,740	540	1,100	67,600	B.
August	630	275	428	26,300	B.
September	284	158	224	13,300	B.
October	7,900	158	1,860	114,000	B.
November	558	326	365	21,700	B.
December	716	292	370	22,800	B.
The year	7,900	158	843	612,000	
1908.					
January	612	319	382	23,500	B.
February	453	294	343	19,700	B.
March	426	285	316	19,400	B.
April	1,540	285	570	33,900	B.
May	6,900	302	1,910	117,000	B.
June	7,350	1,940	5,080	302,000	C.
The period				516,000	

YAZOO RIVER DRAINAGE BASIN.

DESCRIPTION.

Yazoo River is formed by the union of the Tallahatchie and Yalobusha rivers just above Greenwood, Miss., whence it flows southward and southwestward to its junction with the Mississippi at Vicksburg.

Tallahatchie River and its large tributary, the Coldwater, rise in the northern part of Mississippi. Yokona River, also an important tributary of the Tallahatchie, comes in from the east just above the mouth of the Coldwater. Yalobusha River rises in the northern part of the State, farther east than the other tributaries. Sunflower River, which empties into the Yazoo about 20 miles above Vicksburg, drains a large basin along the upper western border of the State, which is cut off from the Mississippi River by the levees.

The drainage area may be divided into two distinct parts, the delta and the uplands. The delta comprises a strip of land east of the Mississippi extending from the state line on the north to Vicksburg on the south, about 60 miles wide at the center and decreasing in width to about 5 miles at either end. The upland comprises the portion of the drainage area located to the east of the delta. The entire delta is a network of small streams and bayous, and during high-water periods a considerable portion of it is under water.

Except for the land that has been cleared for cultivation—at present a relatively small amount—the drainage area is forested. The mean annual precipitation is about 50 inches.

The river is navigable for its entire length and most of the larger tributaries are navigable for small boats. The tributaries are used to some extent for logging.

Neither diversion nor storage is used in any part of the area, except the natural channels that at places carry flood water from one stream to another and the numerous small so-called lakes, which are really old river channels; neither is there any considerable amount of water power developed.

The data collected in the drainage basin are of value for drainage and navigation problems. The Tallahatchie drainage commission is engaged in a drainage project in the upper portion of the basin.

The following stations have been maintained in this river basin:

Tallahatchie River at Batesville, Miss., 1906–1908.
Tallahatchie River at Philipp, Miss., 1908.
Yazoo River at Greenwood, Miss., 1908.
Yazoo River at Yazoo City, Miss., 1900–1905.
Coldwater River at Savage, Miss., 1908.
Yalobusha River at Grenada, Miss., 1906, 1908.
Sunflower River at Ruleville, Miss., 1908.
Sunflower River at Baird, Miss., 1908.

TALLAHATCHIE RIVER AT BATESVILLE, MISS.

This station, which is located at the county highway bridge 1 mile west of Batesville and about 2 miles below the crossing of the Illinois Central Railroad, was established on June 15, 1906, to obtain general run-off data. The record has been continuous since that time except for a break from August 1 to September 19, 1906. The station is now maintained in connection with the Tallahatchie drainage commission.

The ground on the right bank is low for a mile or more, but the road has been raised above high water except at a number of bridged openings.

Discharge measurements can be conveniently made at all stages and the relation between gage heights and discharge should be fairly constant. A chain gage attached to the bridge is used, the datum of which has remained the same.

Discharge measurements of Tallahatchie River at Batesville, Miss., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 24	Warren E. Hall	135	443	2.52	425
1908.					
June 20	M. R. Hall	150	1,160	7.27	2,210
December 10	W. A. Lamb	144	720	4.34	1,090

Daily gage height, in feet, of Tallahatchie River at Batesville, Miss., for 1907 and 1908.

[J. S. Goff, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	9.3	7.4	12.6	5.3	10.7	12.8	4.0	4.5	3.2	2.6	2.9	3.4
2	9.1	10.0	16.1	5.2	10.4	13.4	5.0	4.4	3.0	2.5	3.2	3.3
3	9.7	8.0	17.1	5.1	11.4	13.3	4.5	4.3	2.8	2.5	3.0	3.1
4	10.5	9.8	16.9	5.0	15.5	13.2	4.1	3.9	2.8	2.5	2.9	3.0
5	10.7	9.4	17.1	5.0	16.9	13.0	4.5	3.6	2.7	2.6	2.9	3.0
6	10.5	9.7	17.3	6.2	16.5	12.9	5.0	3.3	2.5	2.5	2.9	3.0
7	10.4	11.6	17.2	6.0	16.6	13.2	5.3	3.3	2.7	2.6	2.8	3.0
8	10.1	12.5	16.8	6.3	16.9	13.3	5.6	3.2	2.6	3.6	2.8	3.0
9	10.1	12.7	16.6	6.8	16.7	12.4	5.4	3.1	2.6	3.7	2.7	3.0
10	10.0	12.5	15.6	7.2	16.2	11.7	4.8	3.0	2.7	3.6	2.7	3.4
11	9.5	12.0	14.5	7.3	15.9	9.2	4.6	2.9	2.7	3.3	2.7	3.8
12	9.0	11.5	13.7	7.0	15.8	6.4	4.7	2.7	2.5	3.1	2.7	3.8
13	7.9	11.0	12.2	7.0	15.8	5.5	4.5	2.8	2.6	2.8	2.7	4.4
14	7.5	8.5	14.2	5.6	15.7	6.3	4.2	2.3	2.6	2.8	2.7	4.4
15	7.3	6.5	14.7	5.2	16.1	6.7	3.9	2.4	2.6	2.8	2.7	4.3
16	7.1	5.3	14.1	5.3	16.1	6.5	3.2	2.5	2.6	2.5	2.7	4.2
17	7.0	8.2	13.0	6.4	15.7	6.2	3.7	2.6	2.6	2.7	2.8	4.1
18	6.9	7.0	13.5	6.5	15.2	6.0	3.6	2.7	2.6	2.6	2.9	4.0
19	6.8	6.5	13.8	6.3	14.3	5.8	3.5	2.8	2.6	2.6	3.0	3.9
20	7.7	6.1	14.3	6.3	14.5	5.3	3.4	2.8	2.6	2.6	3.2	3.8
21	7.7	5.7	14.4	6.5	16.3	5.0	3.3	3.1	2.6	2.6	3.7	3.8
22	7.8	5.3	14.3	6.9	16.2	4.6	3.2	3.2	2.7	2.6	3.6	4.4
23	8.0	4.3	13.9	6.9	15.4	4.3	3.1	3.5	2.5	2.6	3.6	4.7
24	8.4	4.3	13.0	6.6	14.5	4.1	3.0	3.9	2.6	2.6	3.6	4.9
25	8.5	7.3	12.3	6.3	13.7	6.3	3.0	3.2	2.5	2.5	3.6	5.0

Daily gage height, in feet, of Tallahatchie River at Batesville, Miss., for 1907 and 1908— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
26	8.4	9.2	10.0	5.5	11.3	4.7	3.0	3.1	2.6	2.5	3.7	5.2
27	8.0	9.8	8.0	5.4	10.3	4.7	3.1	3.7	2.5	2.8	3.7	5.7
28	7.4	10.0	6.6	5.6	8.0	4.5	3.2	4.3	2.6	2.7	3.7	5.8
29	5.1	.....	6.0	5.8	7.5	4.3	3.4	4.1	2.6	2.5	3.6	6.5
30	6.0	.....	5.5	6.6	10.0	4.2	3.7	3.8	2.5	2.7	3.5	7.6
31	5.5	.....	5.5	.....	12.6	.....	4.1	3.4	.....	2.9	.....	6.5
1908.												
1	6.9	9.1	11.5	13.8	7.6	5.4	3.6	3.3	3.0	3.5	2.3	3.6
2	7.7	6.0	11.0	13.2	7.4	5.6	3.5	3.3	2.9	3.5	2.3	3.7
3	7.5	6.7	10.7	12.1	7.0	5.6	3.6	3.3	2.8	3.5	2.4	3.8
4	8.2	7.3	10.4	10.5	6.8	6.0	3.6	3.5	2.9	3.0	2.4	4.0
5	8.2	8.0	10.8	9.5	8.6	6.3	4.1	3.6	2.7	2.9	2.4	4.1
6	9.0	9.1	11.8	8.3	8.1	7.3	4.5	3.7	2.7	2.8	2.3	4.3
7	9.5	9.1	12.8	7.8	7.8	8.0	4.7	3.8	2.7	2.7	2.3	4.3
8	9.9	9.0	13.2	7.8	7.5	11.8	4.9	3.9	2.6	2.6	2.4	4.3
9	10.1	9.1	13.7	7.9	7.4	14.1	5.4	4.1	2.6	2.4	2.4	4.2
10	10.4	11.1	14.6	7.4	7.3	15.9	5.8	4.2	2.7	2.4	2.5	4.2
11	10.6	11.4	14.9	7.7	7.0	16.6	6.0	4.5	2.6	2.4	2.5	4.2
12	10.3	11.4	14.4	6.7	6.5	16.3	5.8	4.3	2.6	2.4	2.6	4.2
13	9.9	14.2	13.6	6.6	6.0	15.4	5.5	4.2	2.5	2.3	2.6	4.2
14	9.4	15.4	13.6	5.9	5.8	14.3	5.3	3.8	2.5	2.3	2.6	4.1
15	9.6	16.4	11.0	6.0	5.4	13.8	4.7	3.5	2.4	2.2	2.6	4.0
16	8.7	16.5	9.7	6.3	5.2	10.7	4.2	3.6	2.4	2.4	2.6	3.6
17	8.9	17.7	8.6	6.4	5.3	8.0	3.8	3.5	2.4	2.3	2.6	3.5
18	8.4	18.2	7.8	6.8	5.7	7.4	3.6	3.4	2.3	2.3	2.5	3.4
19	8.0	18.0	7.2	7.1	7.2	7.3	3.8	3.3	2.3	2.3	2.5	3.3
20	7.8	17.5	7.6	7.5	7.6	7.1	4.0	3.3	2.7	2.4	2.5	3.3
21	7.8	17.0	8.2	7.4	7.9	6.5	4.5	3.4	2.9	2.4	2.4	3.5
22	7.6	16.5	12.9	7.4	8.0	5.7	4.4	3.5	3.2	2.2	2.5	3.7
23	7.2	15.9	12.7	6.9	8.4	5.0	4.3	3.4	3.8	2.3	2.5	3.9
24	6.7	14.3	12.4	7.0	8.8	4.6	4.5	3.3	3.8	2.4	2.6	4.0
25	6.0	14.8	12.4	6.9	9.0	4.3	4.6	3.1	3.7	2.4	2.7	4.2
26	5.4	13.0	12.4	6.7	9.5	4.1	4.8	3.0	3.7	2.4	2.8	4.3
27	5.1	13.4	12.1	6.5	5.8	3.9	4.2	3.3	3.7	2.3	3.0	4.5
28	4.7	12.6	12.2	6.7	5.3	3.8	3.9	3.2	3.6	2.3	3.3	4.4
29	4.6	12.0	12.9	7.0	5.1	3.7	3.7	3.4	3.6	2.2	3.3	4.4
30	4.8	.....	13.5	7.5	5.0	3.8	3.5	3.3	3.6	2.3	3.4	4.2
31	7.4	.....	14.0	.....	5.2	.....	3.4	3.0	.....	2.4	.....	3.8

Rating table for Tallahatchie River at Batesville, Miss., for 1906–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	365	3.80	883	5.40	1,480	8.00	2,520
2.30	395	3.90	919	5.50	1,520	8.20	2,600
2.40	425	4.00	955	5.60	1,560	8.40	2,690
2.50	455	4.10	991	5.70	1,600	8.60	2,770
2.60	485	4.20	1,027	5.80	1,640	8.80	2,860
2.70	517	4.30	1,063	5.90	1,680	9.00	2,940
2.80	549	4.40	1,099	6.00	1,720	10.00	3,360
2.90	581	4.50	1,135	6.20	1,800	11.00	3,780
3.00	613	4.60	1,173	6.40	1,880	12.00	4,200
3.10	645	4.70	1,211	6.60	1,960	13.00	4,620
3.20	679	4.80	1,249	6.80	2,040	14.00	5,040
3.30	713	4.90	1,287	7.00	2,120	15.00	5,460
3.40	747	5.00	1,325	7.20	2,200	16.00	5,880
3.50	781	5.10	1,363	7.40	2,280	17.00	6,300
3.60	815	5.20	1,401	7.60	2,360	18.00	6,720
3.70	849	5.30	1,440	7.80	2,440		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on six discharge measurements made during 1906–1908 and is fairly well defined below gage height 7.5 feet. Above gage height 8.0 feet the rating curve is a tangent, the difference being 42 per tenth.

Monthly discharge of Tallahatchie River at Batesville, Miss., for 1906, 1907, and 1908.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
1906.				
June 15–30	781	549	574	B.
July	1,400	455	738	B.
September 20–30	3,360	395	1,360	B.
October	5,080	679	2,920	C.
November	6,970	597	2,630	C.
December	5,120	1,920	3,520	C.
1907.				
January	3,650	1,360	2,660	B.
February	4,490	1,060	2,810	B.
March	6,430	1,520	4,730	C.
April	2,240	1,320	1,760	A.
May	6,260	2,520	5,100	C.
June	4,790	991	2,560	C.
July	1,560	613	959	A.
August	1,140	395	719	B.
September	679	455	499	B.
October	849	455	538	B.
November	849	517	651	B.
December	2,360	613	1,060	A.
The year	6,430	395	2,000	
1908.				
January	3,610	1,170	2,510	B.
February	6,800	1,720	4,530	C.
March	5,420	2,200	4,100	C.
April	4,960	1,680	2,470	B.
May	3,150	1,320	2,100	B.
June	6,130	849	2,680	C.
July	1,720	747	1,110	A.
August	1,140	613	799	A.
September	883	395	595	B.
October	781	365	465	B.
November	747	395	485	B.
December	1,140	713	948	A.
The year	6,800	365	1,900	

TALLAHATCHIE RIVER AT PHILIPP, MISS.

This station, located at the Yazoo and Mississippi Valley Railroad bridge at Philipp, was established September 6, 1908, for the purpose of obtaining run-off data in connection with the work of the Tallahatchie drainage commission.

The stream above the station will at times overflow the surrounding country for a distance of several miles on either side. The overflow, however, with small exceptions, is intercepted by the railroad embankment and is made to flow in the main channel at the gaging station. Variations in the relative stage of the river below the station will probably so affect the slope as to disturb the relation between gage heights and discharge.

The datum of the gage is mean sea level so that the gage readings are elevations above sea level.

Discharge measurements of Tallahatchie River at Philipp, Miss., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 13	M. R. Hall	192	2,680	124.38	6,670
December 5	W. A. Lamb	142	1,080	115.35	1,880

Daily gage height, in feet, of Tallahatchie River at Philipp, Miss., for 1908.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		113.9	112.5	114.0	16	112.9	112.5	113.0	117.2
2		113.8	112.5	114.3	17	112.9	112.5	113.1	116.5
3		113.7	112.5	114.6	18	112.8	112.5	113.1	116.0
4		113.5	112.5	114.7	19	112.8	112.5	113.0	115.4
5		113.4	112.5	115.3	20	112.7	112.5	113.0	115.1
6	113.4	113.2	112.5	115.7	21	112.7	112.5	112.9	114.6
7	113.4	113.1	112.5	116.3	22	112.7	112.5	112.8	114.6
8	113.2	113.1	112.5	117.7	23	113.4	112.5	112.8	114.9
9	113.1	113.0	112.5	118.4	24	113.6	112.5	112.8	115.4
10	113.0	112.9	112.5	118.4	25	113.8	112.5	112.9	115.8
11	113.0	112.7	112.6	118.2	26	114.0	112.5	113.0	115.7
12	113.0	112.6	112.6	118.2	27	114.1	112.5	113.2	115.4
13	113.0	112.6	112.6	118.2	28	113.9	112.5	113.8	116.7
14	112.9	112.6	113.0	118.0	29	113.9	112.5	113.9	117.0
15	112.9	112.6	113.0	117.7	30	113.9	112.5	113.9	117.1
					31		112.5		116.9

YAZOO RIVER AT GREENWOOD, MISS.

This station, which is located at the highway bridge at Greenwood, a point about 1 mile below the junction of Yalobusha River, was established July 15, 1908, for the purpose of obtaining general run-off data applicable to navigation and drainage problems.

The conditions at the station are favorable for accurate discharge measurements at all stages, but it is expected that the relation between gage heights and discharge will be greatly disturbed by changes in slope of the the Yazoo River caused by stages of the Mississippi River.

The gage datum is mean sea level and has not been changed. The United States Weather Bureau has maintained a gage here since November 1, 1904, the datum of which was 92.5 feet above sea level.

The gage heights from January 1 to July 15, 1908, are from the United States Weather Bureau gage and have been adjusted to conform to the sea-level datum of the new gage.

Discharge measurements of Yazoo River at Greenwood, Miss., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 17	M. R. Hall	307	5,220	107.84	10,260
July 18	Warren E. Hall	270	2,220	97.60	2,940
July 22	do	270	2,110	97.19	3,110
December 5	W. A. Lamb	252	1,340	94.90	1,920
December 9	do	300	3,380	102.35	6,260

Daily gage height, in feet, of Yazoo River at Greenwood, Miss., for 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	102.5	102.4	124.3	120.6	108.3	102.2	100.1	96.25	94.95	94.3	93.15	94.4
2	103.5	103.2	124.3	120.6	108.1	101.7	99.1	96.0	94.8	94.2	93.15	94.4
3	104.3	103.7	124.2	120.6	108.1	101.2	98.7	96.1	94.6	94.1	93.15	94.45
4	104.9	104.0	124.0	120.5	107.9	100.6	98.4	96.1	94.45	94.0	93.15	94.65
5	106.0	104.5	123.8	120.4	107.9	100.1	98.1	96.5	94.3	93.9	93.15	94.9
6	106.7	104.9	123.7	120.2	110.5	100.8	97.8	97.1	94.3	93.8	93.15	95.55
7	107.2	105.5	123.4	120.0	111.3	102.3	97.5	97.65	94.15	93.75	93.15	98.2
8	107.6	106.1	123.1	119.4	111.0	103.2	97.7	97.1	94.0	93.7	93.2	101.35
9	107.9	106.6	122.9	118.9	110.7	104.1	98.4	96.25	93.9	93.6	93.15	102.25
10	108.2	107.5	122.6	118.5	110.4	105.0	98.9	96.45	93.85	93.5	93.2	102.05
11	108.6	108.8	122.3	117.9	110.0	105.7	99.4	96.65	93.8	93.4	93.2	101.5
12	109.0	110.4	122.0	117.2	109.9	106.3	99.5	96.9	93.75	93.35	93.25	100.9
13	109.2	111.8	121.7	116.6	109.5	106.9	99.5	97.2	93.7	93.35	93.3	100.4
14	109.2	116.1	121.4	115.9	109.4	107.4	99.4	97.3	93.65	93.35	93.3	99.75
15	109.0	118.4	121.0	115.2	109.2	107.5	99.2	97.1	93.65	93.35	93.45	99.75
16	109.0	119.0	120.6	114.5	108.7	107.8	98.9	96.7	93.6	93.3	93.6	98.6
17	109.1	119.5	120.3	113.9	108.4	107.9	98.4	96.45	93.55	93.0	93.6	98.05
18	109.2	120.2	120.0	113.4	108.6	107.9	97.9	96.3	93.5	93.3	93.6	97.35
19	109.1	121.4	119.6	112.5	108.9	107.8	97.3	96.15	93.5	93.25	93.6	96.65
20	109.0	122.6	119.2	111.8	108.5	107.6	96.8	96.35	93.5	93.25	93.5	96.1
21	108.9	123.3	118.9	111.1	108.2	107.5	96.55	96.7	93.45	93.2	93.5	95.9
22	108.7	123.8	118.8	110.5	107.6	107.3	97.0	96.7	93.6	93.2	93.5	96.8
23	108.4	124.2	119.0	109.8	107.1	107.0	97.45	96.7	94.1	93.2	93.5	98.7
24	108.2	124.3	120.0	109.0	106.5	106.7	97.5	96.45	94.45	93.2	93.5	98.5
25	108.4	124.4	120.4	109.2	106.0	106.3	97.4	96.4	94.65	93.15	93.35	98.4
26	107.4	124.5	120.3	109.5	105.6	105.4	97.4	96.3	94.6	93.15	93.7	98.4
27	106.7	124.5	120.2	109.3	105.1	104.7	97.5	95.95	94.6	93.1	93.9	98.4
28	106.0	124.4	120.2	109.0	104.6	103.4	97.4	95.7	94.5	93.1	94.1	98.3
29	105.0	124.4	120.2	108.5	104.1	102.1	97.2	95.5	94.4	93.1	94.2	98.2
30	104.0	.....	120.3	108.3	103.4	101.0	96.9	95.3	94.35	93.1	94.35	98.05
31	102.7	.....	120.5	.....	102.7	.....	96.6	95.1	.....	93.1	.....	97.85

COLDWATER RIVER AT SAVAGE, MISS.

This station is located at the Yazoo and Mississippi Valley Railroad bridge at Savage, about 5 miles below the place where the river leaves the hills and enters the delta. It was established July 1, 1908, for the purpose of determining the amount of water entering the delta from the foothills and is maintained in cooperation with the Tallahatchie drainage commission.

Although there are large overflow areas along the banks of the river, the flow is practically all confined by the railroad embankments to the channel under the bridge and can be conveniently measured at all stages.

The gage is set on sea-level datum, so as to read actual elevations.

Discharge measurements of Coldwater River at Savage, Miss., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 11	M. R. Hall	255	3,490	182.99	5,190
December 2	W. A. Lamb	135	1,440	173.0	1,050

Daily gage height, in feet, of Coldwater River at Savage, Miss., for 1908.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	166.7	165.8	172.7	11	165.7	166.2	172.35	21	165.75	166.0	166.7
2	166.25	165.8	173.0	12	165.7	166.3	170.7	22	165.75	166.0	167.0
3	165.95	165.85	172.4	13	165.7	166.4	168.8	23	165.75	166.1	167.5
4	165.85	165.9	170.6	14	165.7	166.4	167.8	24	165.75	166.25	169.9
5	165.8	165.9	169.3	15	165.7	166.6	167.5	25	165.75	166.4	171.7
6	165.8	165.9	168.0	16	165.7	166.5	167.0	26	165.7	166.65	171.4
7	165.75	165.9	172.5	17	165.7	166.45	166.9	27	165.7	168.72	169.9
8	165.75	165.9	173.7	18	165.75	166.25	166.7	28	165.7	169.5	168.4
9	165.75	166.1	173.75	19	165.75	166.1	166.7	29	165.8	172.1	167.9
10	165.7	166.2	173.55	20	165.75	166.0	166.5	30	165.8	172.35	167.8
								31	165.8	.....	167.9

YALOBUSHA RIVER AT GRENADA, MISS.

This station, which was established on June 14, 1906, for the purpose of obtaining run-off data of general application, is located in the western part of Grenada at the county highway bridge, about one-half mile from the depot and the same distance below the crossing of the Illinois Central Railroad. It is below the mouth of Bataupan Bogue, which comes in a short distance above the railroad bridge. The gage chain was stolen for the second time on November 2, 1906, and the station was temporarily abandoned. On July 7, 1908, the station was again established in connection with the Tallahatchie drainage commission, using the same gage datum as formerly.

The left bank is not liable to overflow; the ground on the right bank is low for a long distance, but is crossed by the public highway embankment, which is above high water except at a few bridged openings.

Conditions are favorable for accurate discharge measurements. It is probable that the station rating will be somewhat affected by backwater from Yazoo River and also by shifting of the stream bed.

Discharge measurements of Yalobusha River at Grenada, Miss., in 1906 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 19	Warren E. Hall	118	1,190	11.20	4,190
May 2	do	80	136	1.85	280
June 14	M. R. Hall	79	132	1.52	232
September 19	do	78	121	1.22	137
Do	do	78	120	1.22	134
1908.					
June 18	M. R. Hall	86	574	3.92	730
December 10	W. A. Lamb	90	775	7.30	1,980

Daily gage height, in feet, of Yalobusha River at Grenada, Miss., for 1908.

[W. C. Carroll, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.05	1.40	1.05	0.85	1.20	16	1.60	1.50	0.90	0.85	0.90	2.10
2	.....	2.00	1.25	1.00	.90	1.20	17	1.45	2.10	.90	.85	.90	2.00
3	.....	1.85	1.20	1.00	.90	1.20	18	1.40	2.00	.90	.90	.85	1.85
4	.....	2.35	1.20	.95	.85	1.15	19	1.30	2.50	.95	.85	.85	1.80
5	.....	2.05	1.20	.90	.85	1.00	20	3.20	4.35	.95	.85	.87	1.80
6	.....	1.90	1.10	.95	.87	2.90	21	3.65	2.40	1.05	.85	.85	1.90
7	2.60	1.75	1.05	.95	.85	12.00	22	4.70	2.15	3.00	.85	.95	6.35
8	2.40	1.65	1.10	.95	.85	9.00	23	4.55	2.25	2.10	.85	.95	6.40
9	2.35	1.95	1.05	.95	.87	8.50	24	2.95	1.85	1.80	.85	1.00	6.35
10	2.70	2.00	1.05	.90	.85	7.40	25	2.55	2.10	1.65	.88	1.30	6.75
11	2.20	2.05	1.05	.90	.87	6.00	26	2.5	2.75	1.45	.80	1.20	6.60
12	2.35	1.65	.95	.90	.90	3.85	27	2.25	2.50	1.40	.80	1.10	4.00
13	2.25	1.50	.95	.85	.90	3.40	28	1.95	2.05	1.35	.86	1.00	3.60
14	2.01	1.40	.90	.85	.90	3.00	29	2.00	1.65	1.15	.80	1.00	3.20
15	1.80	1.45	.90	.90	.93	2.25	30	1.70	1.60	1.05	.85	1.05	2.75
							31	1.60	1.50	.....	.80	.....	2.50

Rating table for Yalobusha River at Grenada, Miss., from June 14, 1906, to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	118	2.20	307	3.60	639	6.00	1,470
.90	125	2.30	327	3.70	667	6.20	1,550
1.00	133	2.40	347	3.80	697	6.40	1,630
1.10	143	2.50	367	3.90	727	6.60	1,710
1.20	153	2.60	389	4.00	757	6.80	1,790
1.30	165	2.70	411	4.20	821	7.00	1,880
1.40	177	2.80	433	4.40	885	8.00	2,350
1.50	191	2.90	457	4.60	955	9.00	2,860
1.60	205	3.00	481	4.80	1,025	10.00	3,460
1.70	221	3.10	505	5.00	1,095	11.00	4,060
1.80	237	3.20	531	5.20	1,165	12.00	4,660
1.90	253	3.30	557	5.40	1,235		
2.00	271	3.40	583	5.60	1,310		
2.10	289	3.50	611	5.80	1,390		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon seven discharge measurements made during 1906–1908 and is fairly well defined. Above gage height 8.9 feet the rating curve is a tangent, the difference being 60 per tenth.

Monthly discharge of Yalobusha River at Grenada, Miss., for 1906 and 1908.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
1906.				
June 14–30	757	143	270	C.
July	853	143	389	C.
August 26–31	253	133	177	C.
September	6,100	125	892	B.
October	8,740	177	2,770	B.
November 1–17	184	171	173	C.
1908.				
July 7–31	990	165	359	C.
August	869	177	285	C.
September	481	125	165	C.
October	138	118	124	C.
November	165	122	128	C.
December	4,660	133	952	B.

SUNFLOWER RIVER NEAR RULEVILLE, MISS.

This station, which was established June 15, 1908, and which is maintained in cooperation with the Tallahatchie drainage commission, is located at the new iron wagon bridge 3 miles southwest of Ruleville, Miss.

The drainage area above the station is very flat and is cut by a number of small tributaries and bayous. The river at the station and below has a very small amount of slope, making the current too sluggish for measurements at times. The amount of slope and consequently of velocity varies greatly with the stage of Mississippi River, making it impossible to rate the station in the usual way by basing daily discharges upon the daily gage heights.

As the gage is set to sea-level datum, the gage readings are actual elevations above sea level. The gage readings for 1908 were fragmentary and inaccurate and hence are not published.

Discharge measurements of Sunflower River near Ruleville, Miss., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 15	M. R. Hall	195	1,320	100.02	746
December 8	W. A. Lamb	213	1,760	97.9	286

SUNFLOWER RIVER AT BAIRD, MISS.

This station, which is located at the Southern Railway bridge one-half mile west of Baird, Miss., was established June 16, 1908, but the gage was not put in until October 4, 1908. It is maintained in cooperation with the Tallahatchie drainage commission.

Owing to the great variation in height of the outlet of Sunflower River into the Mississippi through the lower portion of Yazoo River, and consequently in the slope of Sunflower River, there is no relation whatever between gage heights and discharge at this station.

As the gage is set on sea-level datum, the readings are elevations above the sea level.

The United States Army Engineers have maintained a gage at this station for a portion of the time, and the gage heights prior to October 4, 1908, are from their records corrected to the sea-level datum of the new gage.

Discharge measurements of Sunflower River at Baird, Miss., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 16	M. R. Hall	254	3,450	95.32	1,110
July 23	Warren E. Hall	179	1,030	84.47	588
July 24	do	179	981	84.22	591
December 7	W. A. Lamb	173	990	84.55	689

Daily gage height, in feet, of Sunflower River at Baird, Miss., for 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	98.4	95.5	95.0	93.7	.....	.....	82.8	82.7	82.9
2	.....	98.0	95.5	95.0	93.5	.....	.....	82.8	82.7	82.9
3	.....	97.5	95.5	95.1	93.4	.....	.....	82.8	82.7	82.9
4	.....	97.0	95.4	95.4	93.4	.....	83.1	82.8	82.7	82.9
5	.....	96.5	96.1	95.4	93.0	.....	83.1	82.8	82.7	82.9
6	.....	95.6	96.9	95.5	92.9	.....	83.1	82.8	82.7	83.0
7	.....	96.0	97.1	95.5	92.5	.....	83.0	82.8	82.7	84.6
8	.....	95.7	97.0	95.7	92.2	.....	83.0	82.8	82.7	84.1
9	.....	95.5	.....	95.8	91.9	.....	83.0	82.8	82.7	83.8
10	.....	95.4	96.0	95.9	91.5	.....	83.0	82.8	82.7	83.6
11	.....	95.4	95.7	95.9	91.1	.....	83.0	82.8	82.7	83.5
12	.....	95.4	95.4	95.9	90.9	.....	82.9	82.8	82.7	83.4
13	.....	95.0	95.2	95.9	90.4	.....	82.9	82.7	82.7	83.1
14	.....	95.0	95.0	95.6	89.9	.....	82.9	82.7	82.7	83.0
15	93.5	95.0	95.0	95.8	89.5	.....	82.9	82.7	82.7	83.0
16	93.5	95.0	94.9	95.6	88.9	.....	82.9	82.7	82.7	83.0
17	93.5	95.1	94.9	95.6	88.1	.....	82.9	82.7	82.7	83.0
18	93.5	95.1	95.2	95.4	87.5	.....	82.9	82.7	82.7	83.0
19	93.6	95.0	95.9	95.3	86.9	.....	82.9	82.7	82.7	82.9
20	93.6	94.8	96.0	95.2	86.4	.....	82.8	82.7	82.7	82.9
21	93.7	94.5	95.9	95.0	85.8	.....	82.8	82.7	82.7	83.2
22	93.8	94.5	95.7	94.9	85.1	.....	82.8	82.7	82.7	84.0
23	95.5	94.5	95.4	94.7	84.6	.....	82.8	82.7	82.7	84.6
24	97.6	94.9	95.1	94.6	84.3	.....	82.8	82.7	82.8	84.6
25	100.1	95.4	94.9	94.5	83.7	.....	82.8	82.7	82.8	84.6
26	100.6	95.4	94.8	94.4	.....	.....	82.8	82.7	82.8	84.5
27	100.7	95.4	94.7	94.3	.....	.....	82.8	82.7	82.8	84.2
28	100.5	95.5	94.6	94.1	.....	.....	82.8	82.7	82.8	84.1
29	100.0	95.5	94.5	93.9	.....	.....	82.8	82.7	82.8	83.9
30	99.5	.....	94.5	93.9	.....	.....	82.8	82.7	82.9	83.8
31	99.0	.....	94.9	.....	.....	.....	.....	82.7	.....	83.5

MISCELLANEOUS MEASUREMENTS IN LOWER MISSISSIPPI RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in lower Mississippi River drainage basin during 1904, 1907, and 1908:

Miscellaneous measurements in lower Mississippi River basin.

ARKANSAS RIVER.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
July 23, 1908	Arkansas River	Mississippi River	Nepesta, Colo		444
July 23, 1904	Fuses Creek [a]	South Fork of Arkansas River.	Above Salida, Colo		8.3
Do	South Fork of Arkansas River.[a]	Arkansas River	Garfield, Colo		23.8
Mar. 10, 1907	Fountain Creek	do	Buttes, Colo		[b] 4
Feb. 14, 1907	do	do	Fountain, Colo		[b] 20
Mar. 28, 1907	do	do	do		[b] 10
Feb. 14, 1907	St. Charles River	do	San Carlos, Colo		[b] 2
Mar. 28, 1907	do	do	do		[b] 1
Feb. 14, 1907	Huerfano River	do	Huerfano, Colo		[b] 20
Mar. 28, 1907	do	do	do		0
May 24, 1907	do	do	do		[b] 15
June 15, 1907	do	do	do		[b] 20
Aug. 5, 1907	do	do	do		[b] 15
Feb. 14, 1907	Cucharas River	Huerfano River	Walsenburg, Colo		[b] 0.5
Aug. 15, 1907	Purgatory River	Arkansas River	Las Animas, Colo		[b] 40
Oct. 15, 1907	Horse Creek	do	Holly, Colo		[b] 20
Nov. 3, 1908	Canadian River	do	Logan, N. Mex		32.5
Dec. 22, 1908	do	do	do	[c] 2.15	43
July 10, 1907	Rayado River	Cimarron River	Abreu's ranch, 18 miles above Springer, N. Mex.		8.5
Oct. 11, 1907	do	do	do		6
Oct. 31, 1908	do	do	do		3
Oct. 9, 1907	Las Casas Creek	Mora River	Above forks, 12 miles northwest of Mora, N. Mex.		1.9
Oct. 10, 1907	Cebolla Creek	do	La Cueva, N. Mex		2.2
Aug. 14, 1908	Sapello River	do	San Ignacio, N. Mex		12.5
Oct. 28, 1908	Manuelitos Creek	Sapello River	Sapello, N. Mex		3.8

RED RIVER.

Jan. 7, 1907	Antelope Spring	Washita River	Sulphur, Okla		3.2
Do	do	do	do		3.4
Do	Buffalo Spring	do	do		6.1
Do	Sulphur Creek	do	do		10.7

YAZOO RIVER.

Dec. 3, 1908	Tallahatchie River	Yazoo River	Polkville, Miss	155.80	1,860
Dec. 4, 1908	do	do	Locopolis, Miss	125.00	1,760
Do	do	do	Swan Lake, Miss	120.15	1,770
June 12, 1908	Coldwater River	Tallahatchie River	At railroad bridge 3 miles from Marks, Miss., near Hinchcliffe, Miss.	150.18	3,110

[a] Record furnished by George H. Sethman, consulting engineer, Denver, Colo.
[b] Estimated.
[c] New gage established this date.

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O

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 248

SURFACE WATER SUPPLY OF THE UNITED STATES

1907–8

PART VIII. WESTERN GULF OF MEXICO

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

W. B. FREEMAN, W. A. LAMB, AND
R. H. BOLSTER

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SURFACE WATER SUPPLY OF WESTERN GULF OF MEXICO, 1907-8.

By W. B. Freeman, W. A. Lamb, and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country.

These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a pubilc utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly produc-

tive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel, that channel becomes so gorged with water, which it had not hitherto been called upon to convey, that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually, and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
			VIII	248	Western Gulf of Mexico.
III	243	Ohio River basin.	IX	249	Colorado River basin.
IV	244	St. Lawrence River basin.	X	250	Great Basin.
V	245	Upper Mississippi River and Hudson Bay basins.	XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	...do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18 Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	....do	1903.
W. S. 124 to 135	....do	1904.
W. S. 165 to 178	....do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907–8.
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65,75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47, (48)	65,75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65,75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35), 36	48	65,75	(82), 83	(97), 98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65,75	83	98	127	168	204	242
St. Lawrence River	36	49	65,75	(82), 83	97	129	170	206	244
Hudson Bay			66,75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48, (49)	65,75	83	98	128	169	205	243
Upper Mississippi River	36	49	65,75	83	98, (99)	128, (130)	171	207	245
Missouri River	(36), 37	49, (50)	66,75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66,75	(83),84	(98), 99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66,75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37), 38	50	66,75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66,75	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66,75	85	100	134	177	213	251
North Pacific coast	38	51	66,75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35.	James.	
36.	Missouri.	Gallatin.
37.	Colorado.	Green, Gunnison, Grand above junction with Gunnison.
38.	Sacramento.	Except Kings and Kern.
39.	Great Basin.	Mohave.
48.	Delaware.	Wissahickon and Schuylkill.
49.	Ohio.	Scioto.
50.	Missouri.	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65.	Lower Mississippi.	Yazoo.
82.	James.	
	St. Lawrence.	Lake Ontario, tributaries to St. Lawrence River proper.
83.	Lower Mississippi.	Yazoo.
97.	James.	
98.	Lower Mississippi.	Do.
99.	Upper Mississippi.	Tributaries from the west.
128.	Lower Mississippi.	Yazoo.
130.	Upper Mississippi.	Tributaries from the west.
131.	Missouri.	Platte, Kansas.
134.	Colorado.	Data near Yuma, Ariz., repeated.
	Great Basin.	Susan, Owens, Mohave.
169.	Lower Mississippi.	Yazoo.
177.	Colorado.	Below junction with Gila.
	Great Basin.	Susan repeated, Owens, Mohave.
	North Pacific coast.	Rogue, Umpqua, Siletz.
205.	Lower Mississippi.	Yazoo, Homochitto.
213.	Colorado.	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin.	Owens, Mohave.
251.	Colorado.	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin.	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the

basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to a depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on one square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.

1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11} = \text{net horsepower on water wheel realizing 80 per cent of theoretical power.}$

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 11, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which

accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200[a]) and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The editions of both of these water-supply papers are practically exhausted. They can, however, be consulted at most of the larger libraries of the country or they can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents for No. 180 and 35 cents for No. 200. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent in the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in

[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

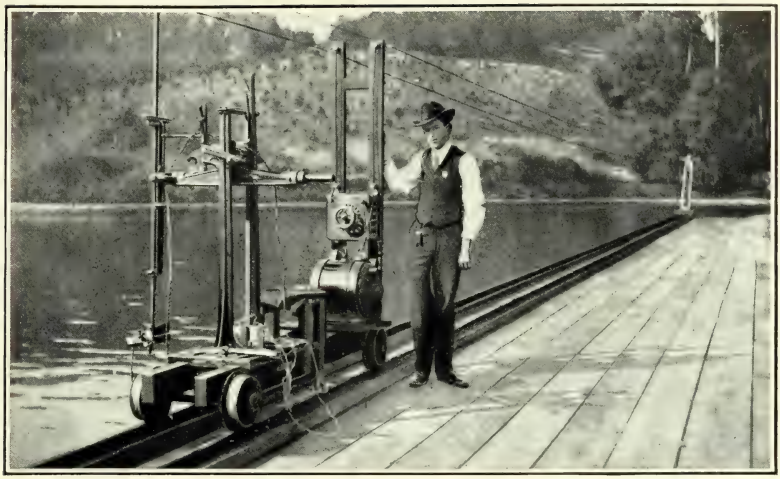
order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth at the time of measurement.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total discharge of the stream. (For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.)



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0.8 depth method.

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method with its various modifications of surface, subsurface, and tube or rod floats is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides of the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared which gives the velocity per second of moving water for any number

of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

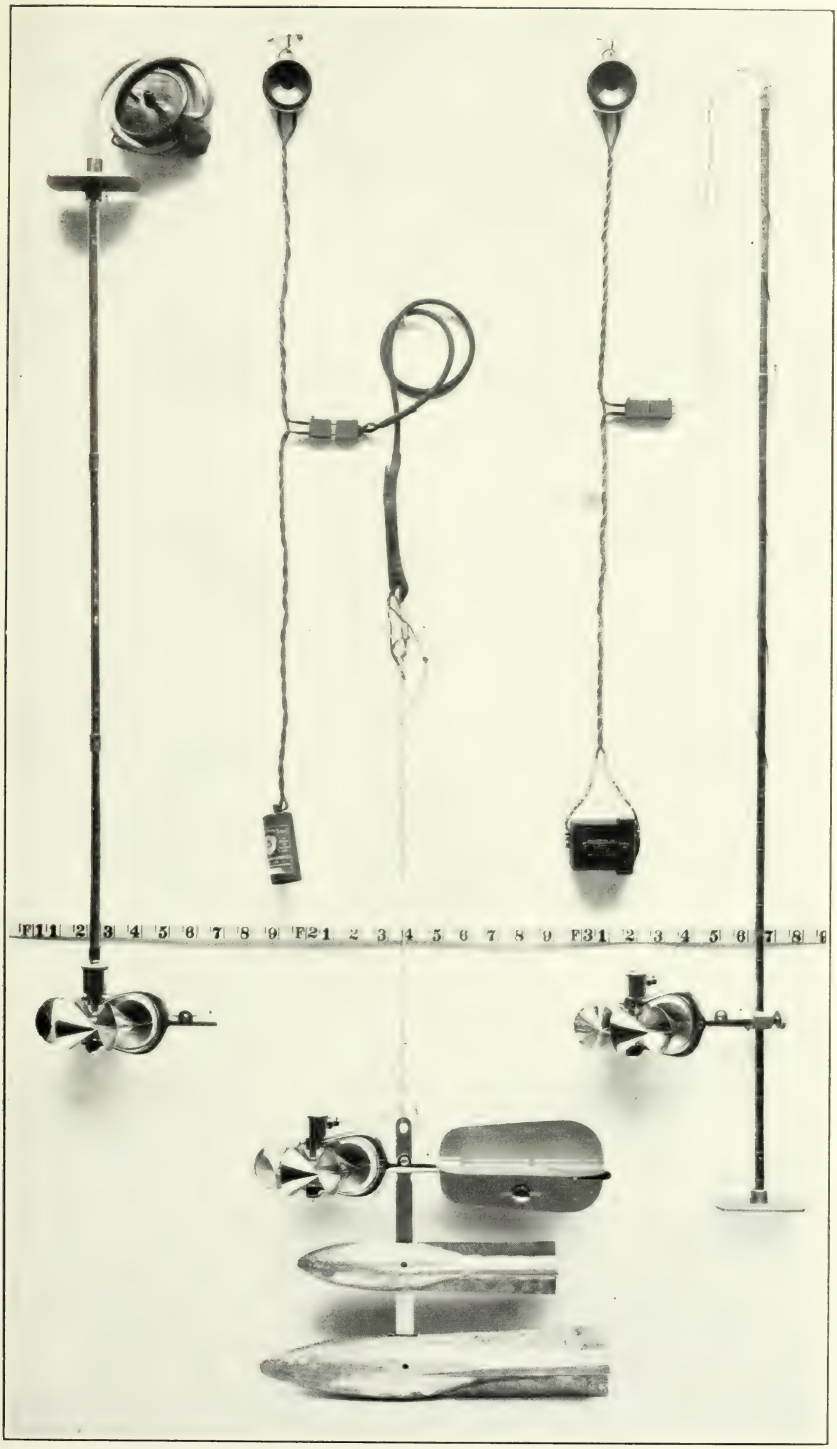
The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, *B*.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean



PRICE PENTA-RECORDING CURRENT METERS.

velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater that in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and

from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see fig. 1 and Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are as a rule comparatively permanent during low and medium stages and when the flow is sufficiently well defined by an adequate number of discharge

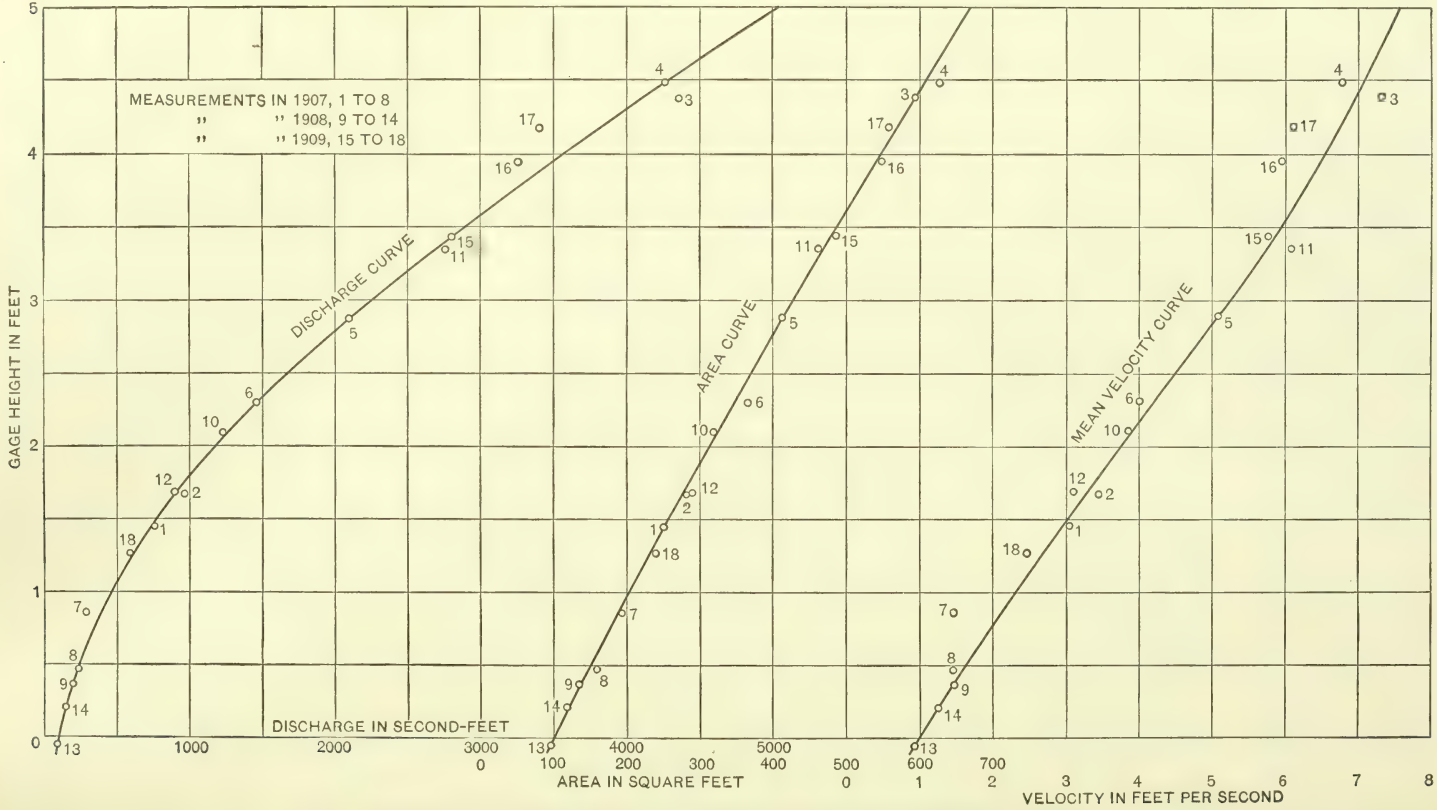


FIGURE 1.—Discharge, area, and mean velocity curves of Rio Grande near Creede, Colo.

measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. For illustrative examples of stations of this type see Water-Supply Paper 246.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage of error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either

reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is

assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abandoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can alone dictate the course to pursue in such cases. For illustrative examples of stations of this type, showing the Bolster method of determining the daily discharge graphically, see Water-Supply Papers 247 and 249.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous

tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly discharge table. In the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly-discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed

results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

Special acknowledgments are due to the following parties for assistance rendered and records furnished: The International Boundary Commission, Gen. Anson Mills, commissioner on the part of the United States; Señor Don Jacobo Blanco, commissioner on the part of Mexico; W. W. Follett, consulting engineer on the part of the United States; the territorial engineer of New Mexico, who has paid more than half of the expense of maintaining records in the Rio Grande drainage in New Mexico, except those on Pecos River; the state engineer of Colorado, who has paid the gage observers at most of the Rio Grande stations in Colorado, and has materially assisted in the work financially and otherwise, and Mr. Antoine Jacob.

The United States Reclamation Service has paid practically all the expense of maintaining gaging stations in the Pecos River drainage.

Thanks are due Mr. A. L. Fellows for valuable suggestions; the Denver and Rio Grande Railroad for transportation furnished in 1907; the United States Weather Bureau and United States Forest Service for the data which they have furnished, and the various engineers and power and irrigation companies which have given us data.

DIVISION OF WORK.

The field data in the Rio Grande drainage basin, except for those stations maintained by the United States International Boundary Commission, were collected under the direction of W. B. Free-

man, district engineer, R. I. Meeker and W. A. Lamb, district hydrographers, assisted by J. B. Stewart, Robert L. Cooper, C. L. Chatfield, and various engineers of the United States Reclamation Service. The New Mexico work since July 1, 1907, has been under the more immediate supervision of Vernon L. Sullivan, territorial engineer, assisted by C. D. Miller.

The data furnished by the United States International Boundary Commission were computed under the direction of W. W. Follett from the discharge measurements.

The data, ratings, and special studies of the completed data of the stations maintained by the United States Geological Survey were prepared by W. B. Freeman and R. H. Bolster. The computations and the preparation of the completed data for publication were made under the direction of R. H. Bolster, assistant engineer, assisted by R. C. Rice, J. G. Mathers, H. D. Padgett, and M. I. Walters.

The entire report was edited by Mrs. B. D. Wood.

RIO GRANDE DRAINAGE BASIN.

GENERAL FEATURES.

The Rio Grande Basin is a long, narrow strip of country extending from the southern part of Colorado southeastward to the Gulf of Mexico. The perennial supply of water for the upper third of this basin comes principally from a comparatively small area of about 2,000 square miles of lofty mountains in Colorado and the extreme northern part of New Mexico.

The Conchos enters the river from the Mexican side some 200 miles below El Paso and brings a good perennial flow as well as enormous floods in the summer and fall. Pecos and Devils rivers and a number of springs also contribute substantial reinforcement to the perennial supply, and other tributaries furnish frequent flood discharges, so that the "lower river" is a considerable stream and is not dependent on the mountain area for its perennial flow. The flood season above the Conchos is in May and June; below that stream it is in August and September. Frequently the river is dry at El Paso when the lower river country is inundated. In addition to the areas contributing a perennial supply of water and a spasmodic supply, there is a vast area of lost river basins from which no water comes at any time, but which from topographic features may be included within this great catchment basin.

The Rio Grande rises in the mountainous area to the south and east of the Continental Divide in southwestern Colorado, flows eastward for a time as a mountain stream, enters the San Luis Valley about 80 miles below its source. In this valley it receives from the north the waters of Saguache and San Luis rivers by seepage, if at all; from

the west, near the lower end of the valley, Alamos, La Jara, and Conejos rivers; and from the east the Trinchera, Culebra, and Rio Costilla. About 4 miles north of the Colorado state line it enters a long canyon locally known as the Rio Grande canyon. From the east there enter this canyon two good tributaries, Red River and Rio Hondo.

The general slope of the valley is still toward the south, the river descending, however, more rapidly than does the surface of the country. This canyon is 300 or 400 feet deep in places, appearing from above as a gash in an otherwise level mesa. Its southern end is 3 miles above Embudo, N. Mex., where the walls open and the river enters the Espanola Valley. While in the valley above Embudo the river receives from the east Taos River, Embudo Creek, and other small streams, and in the Espanola Valley it is increased by the Chama, flowing in from the west, and by a number of streams from the east.

At the lower end of Espanola Valley the river passes through White Rock canyon, a gorge in a range of hills stretching from the Jemez to the Santa Fe Mountains. From Pena Blanca, near the lower end of this canyon, nearly to Socorro the river flows in a valley from 1 to 3 miles wide, bounded on each side by mesas from 300 to 600 feet above the river. About 20 miles below Pena Blanca the Jemez enters from the west, and 60 miles or more below Albuquerque the Puerco comes in from the same side. The Puerco is a torrential stream with no perennial flow. Below these streams the Rio Grande has no tributaries of note until the Pecos comes in about 400 miles by river below El Paso.

At and below Socorro the valley contracts until it becomes too narrow for agriculture, but from San Antonio to San Marcial it is from 1 to 2 miles wide. Below San Marcial the river swings to the west around the Cristobal and Caballos mountains, which lie along the west edge of the Jornada del Muerto, the valley from San Marcial to Rincon being narrow, low, and marshy. At Rincon the river enters a canyon, which extends to Fort Selden, a distance of 15 miles. The Mesilla Valley, the most fertile valley in New Mexico, begins below Fort Selden and extends to the pass above El Paso, a distance of over 50 miles. Above El Paso the banks of the river again assume the canyon-like character for 3 miles, and the river passing this enters the Ysleta Valley, now commonly called the El Paso Valley.

The canyons above these valleys are not cut into hard, indurated rocks, but are bordered in many places by steep walls of comparatively soft, friable sandstones, alternating with conglomerates or beds of clay, the whole series in the northern part of New Mexico, at least, being capped by a vesicular lava. The fall through these can-

yons being great, the down-cutting is rapid, and thus the waters are supplied constantly with fresh detritus, part of which is deposited in turn in the valley below.

From El Paso to the Gulf the river forms the boundary between Mexico and the United States.

From source to mouth the Rio Grande is nearly 2,000 miles long, and its total drainage area comprises about 248,000 square miles.

Many national forests have been established on the headwaters of the Rio Grande and its tributaries, both in Colorado and New Mexico. The drainage basin of the Rio Grande, exclusive of the Pecos, includes between 5,000 and 6,000 square miles of merchantable timber land, 6,000 square miles of woodland and sparsely timbered land, and 2,000 square miles of burned and cut-over land, the remainder being sage brush and open land.

The five largest tributaries are the Conchos, which enters from the Mexican side 200 miles below El Paso; the Conejos, which joins the Rio Grande just above the Colorado-New Mexico line; the Chama, which enters it in the Espanola Valley; the Pecos, which joins it in the southwestern part of Texas; and Devils River, about 50 miles below the Pecos. Most of the remaining tributaries are intermittent in character.

The mountains at the headwaters reach altitudes up to 14,000 feet above sea level. At Albuquerque, N. Mex., the elevation of the river is 5,000 feet, and it leaves the territory at an elevation of about 4,000 feet.

The rainfall varies greatly from year to year and from source to mouth, its irregularity making it very difficult to give averages. The annual precipitation in the mountainous district of Colorado—that is, along the upper Rio Grande—ranges from 15 to 25 inches. In the northern part of New Mexico it ranges from 10 to 15 inches and in the southern part from 5 to 12 inches.

In the mountains of Colorado the river is covered with a foot or more of ice from early in the winter until late in the spring. During severe winters the river is frozen over at times in northern New Mexico, and the snowfall is often very heavy. From the melting of the snows in Colorado and New Mexico come the spring floods.

Irrigation is now practiced extensively in the following valleys along the Rio Grande and its smaller tributaries:

1. *San Luis Valley,* beginning a short distance above Del Norte and extending to the mouth of Conejos River. This district contains probably the largest cultivated area along the Rio Grande, aggregating nearly one-half million acres.

2. *Valleys of the Taos district,* lying on the east side of the river below the Colorado line and including the following valleys: Cuesta,

Rio Colorado, San Cristobal, Arroyo Hondo, and Taos. The Taos Valley far surpasses the others both in water facilities and in area cultivated.

3. *Espanola Valley*, located south of the Taos district and Tres Piedras Mesa. It lies along the river, and, as in the Taos country, agriculture has been engaged in for years.

4. *Albuquerque district*, including the valley from Pena Blanca to San Marcial. The system of irrigation is practically the same as the old Pueblo Indian system. In the last few years, however, new settlers have adopted progressive methods and have greatly increased the duty of water.

5. *Mesilla Valley*, next to the San Luis, is the most important agricultural area along the Rio Grande. The valley broadens just below Selden and continues generally broad and fertile for a distance of 35 miles or beyond the Texas line. A view of the Leasburg diversion dam of the Rio Grande project of the United States Reclamation Service is presented in Plate III, *A*.

Along the Rio Grande and its tributaries in Colorado and New Mexico are available reservoir sites equal to storing of all flood waters. The largest reservoir in the country is about to be built near Engle, N. Mex. It will impound 2,500,000 acre-feet of water for the irrigation of 200,000 acres of land in New Mexico, Texas, and Mexico.

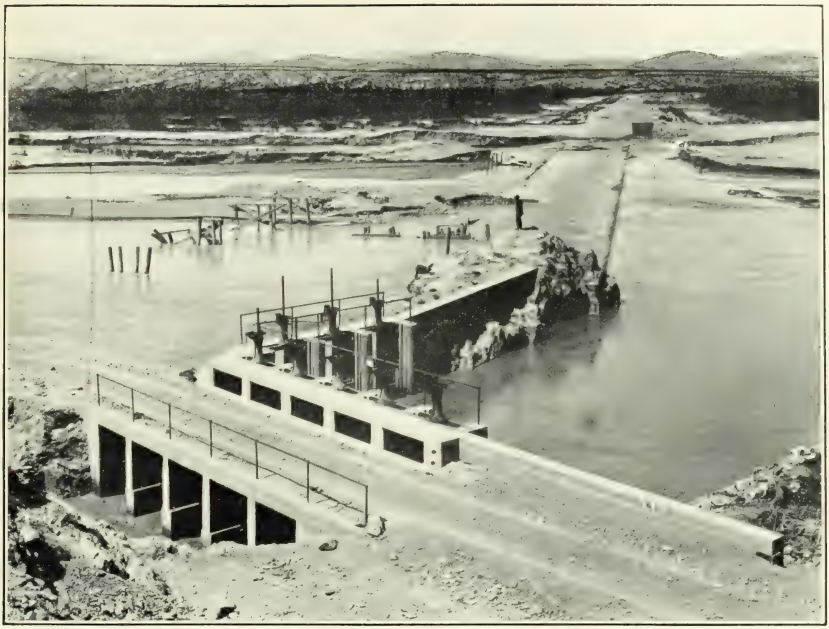
The estimated power possibilities of the Rio Grande and its tributaries from its source to El Paso, Tex., are theoretically as follows:

Minimum horsepower	123,500
Minimum horsepower, 6 high months	241,000
Horsepower from storage 6 months period	405,000

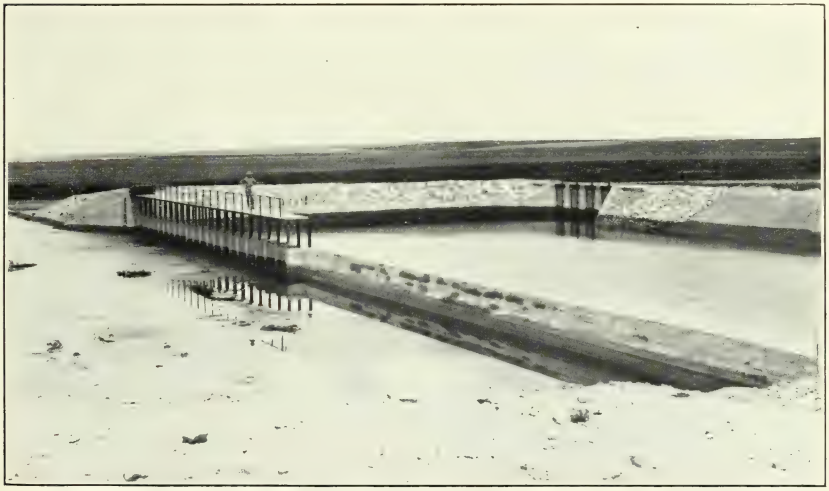
Developments will, however, be made chiefly on the upper tributaries in Colorado and a few of the mountain streams in New Mexico, and will not amount to more than 100,000 horsepower. At present, very few water-power plants of any importance are operated in the drainage basin. The waters of the Rio Grande have been used only for irrigation and domestic purposes, but some of the tributaries have also been used in mining.

The wettest years on the upper Rio Grande appear to be 1906 and 1907; 1902 and 1908 are low-water years.

The determination of the amount of water in the Rio Grande is of importance, both on account of its use in irrigation and from its bearing upon interstate and international distribution of water. Most of the New Mexico and all the Texas stations down to Eagle Pass are maintained by the United States section of the International Boundary Commission. The data for the following stations have been collected by W. W. Follett, consulting engineer for the commis-



A. LEASBURG DIVERSION DAM AND INTAKE GATES OF MAIN RIO GRANDE CANAL, RIO GRANDE PROJECT, NEW MEXICO.



B. WEIR AND SCOUR GATE IN MAIN INLET CANAL AT INLET OF HONDO RESERVOIR, HONDO PROJECT, NEW MEXICO.

sion, and have been furnished through the courtesy of Gen. Anson Mills, commissioner.

Rio Grande near San Marcial, N. Mex.
Rio Grande near El Paso, Tex.
Rio Grande above Presidio, Tex.
Rio Grande below Presidio, Tex.
Rio Grande near Langtry, Tex.
Rio Grande near Devils River (below mouth), Texas.
Rio Grande at Eagle Pass, Tex.
Pecos River near Moorhead, Tex.
Devils River near Devils River Station, Tex.

On account of the shifting character of the river beds at the International Boundary stations, no rating tables have been prepared. The estimated monthly discharges are from daily discharges computed by Mr. Follett directly from the discharge measurements.

The five stations from Laredo down (Laredo, Roma, Brownsville, Salado near Guerrero, and San Juan at Santa Rosalia ranch) are maintained by the Mexican section of the commission.

The following is a list of the gaging stations maintained in the Rio Grande drainage basin, with the exception of the Pecos River stations, together with the length of records:

Rio Grande near Creede (Wason), Colo., 1907–8.
Rio Grande near Del Norte, Colo., 1889–1908 except 1907.
Rio Grande near Lobatos (Cenicero), Colo., 1899–1908.
Rio Grande near Alamosa, Colo., 1894, 1895, 1903.
Rio Grande near Embudo, N. Mex., 1889–1903.
Rio Grande near Buckman, N. Mex., (Rio Grande near San Ildefonso) 1895–1905.
Rio Grande near San Marcial, N. Mex., 1895–1908.
Rio Grande near El Paso, Tex., 1889–1893, 1897–1908.
Rio Grande near Fort Hancock, Tex., 1900–1903.
Rio Grande above and below Presidio, Tex., 1900–1908.
Rio Grande near Langtry, Tex., 1900–1908.
Rio Grande near Devils River (below mouth), Tex., 1900–1908.
Rio Grande near Eagle Pass, Tex., 1900–1908.
Rio Grande near Nuevo Laredo, Tamaulipas, Mexico, 1900–1903.
Rio Grande near Laredo, Tex., 1903–1908.
Rio Grande near Roma, Tex., 1900–1908.
Rio Grande near Brownsville, Tex., 1900–1908.
Conejos River near Mogote, Colo., 1899, 1900, 1903–1908.
Chama River near Abiquiu, N. Mex., 1895–1897.
Santa Fe Creek at Santa Fe, N. Mex., 1907–8.
Mimbres River near Faywood, N. Mex., 1908.
Cameron Creek at Fort Bayard, N. Mex., 1907–8.
Stephens Creek at Fort Bayard, N. Mex., 1907–8.
Devils River near Devils River, Tex., 1900–1908.
Rio Salado at Guerrero, Tamaulipas, Mexico, 1900–1908.
Rio San Juan at La Quemada, Tamaulipas, Mexico, 1900–1902.
Rio San Juan at Santa Rosalia ranch, Tamaulipas, Mexico, 1902–1908.

RIO GRANDE PROPER.

RIO GRANDE NEAR CREEDE, COLO.

This station, which was established April 24, 1907, to obtain information concerning the quantity of run-off of the upper Rio Grande available for storage, is located at the three-span highway bridge one-quarter mile south of Wason siding, on the Creede branch of the Denver and Rio Grande Railroad, about 3 miles from Creede, the terminus of the line, and is a few miles above the site of the proposed dam and reservoir.

Willow Creek (or Goblin Creek) enters the river a short distance upstream from Wason, and Goose Creek comes in at Wagon-wheel Gap about 5 miles below. The drainage at the station is about 700 square miles.

Except for a little meadow irrigation, no water is diverted above this station. Two or three reservoirs are about to be constructed on the upper waters of the Rio Grande and its tributaries above Wason. Among others may be mentioned the Farmers' Union Irrigation Company's reservoir on the main stream, about 35 miles above. The proposed reservoir near Wason will have a capacity almost equal to the normal annual flow of the river.

The winters are long and very severe in this locality, and the stream has a heavy ice cover for several months. The bridge piers cause eddies which materially affect the accuracy of measurements. The river channel is rough, and the velocity high at flood stages, so that results obtained at this station at high stages are only fair. The low and medium water portions of the rating are excellent. For illustration of rating curve for this station see figure 1, page 21.

The datum of the gage has not been changed since the station was established.

Discharge measurements of Rio Grande near Creede, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 24	R. I. Meeker	116	249	1.45	759
May 15	W. B. Freeman	116	280	1.67	962
June 14	do	116	594	4.38	4,350
June 26	do	116	627	4.49	4,260
July 22	do	116	411	2.88	2,090
August 30	C. L. Chatfield	116	364	2.30	1,460
October 9	J. B. Stewart	101	192	.86	281
November 9	W. B. Freeman	95	158	.47	230
1908.					
March 29	J. B. Stewart	69	134	.37	196
May 17	W. B. Freeman	114	317	2.10	1,220
June 12	J. B. Stewart	115	461	3.35	2,750
July 14	do	116	289	1.69	897
November 16	W. B. Freeman	60.5	95	−.05	86
Do	do	68.5	118	.21	150

Daily gage height, in feet, of Rio Grande near Creede, Colo., for 1907 and 1908.

[Henry H. Wason, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1			1.58	2.70	5.40	2.22	1.98	0.90	0.65	0.48
2			1.55	2.70	5.32	2.20	1.95	.85	.62	.45
3			1.58	2.80	5.25	2.15	1.85	.....	.60	.45
4			1.60	3.15	5.22	2.08	1.75	.....	.58	.42
5			1.55	3.70	5.10	2.12	1.40	.....	.60	.48
6			1.50	3.85	5.08	1.98	1.42	.....	.55	.50
7			1.45	4.10	5.02	2.02	1.35	.80	.58	.45
8			1.40	.....	4.85	1.90	1.32	.82	.55	.48
9			1.40	.....	4.78	1.82	1.32	.82	.58	.45
10			1.50	.....	4.55	1.75	1.35	.85	.52	.48
11			1.85	.....	4.60	1.70	1.28	.85	.50	.52
12			2.15	.....	.....	2.05	1.28	.82	.45	.50
13			2.05	4.20	.....	2.38	1.25	.75	.50	.58
14			1.75	4.50	.....	2.15	1.22	.75	.45	.60
15			1.75	.....	.....	1.95	1.22	.75	.45	.....
16			1.90	.....	.....	1.88	1.20	.70	.42	.....
17			2.45	4.90	.....	1.72	1.22	.68	.42	.....
18			2.50	4.78	.....	1.58	1.22	.70	.42	.....
19			2.88	4.55	.....	1.60	1.20	.65	.40	.....
20			3.45	4.15	.....	1.58	1.18	.65	.45	.....
21			3.90	3.90	3.00	1.48	1.15	.62	.40	.....
22			3.95	.....	3.02	1.48	1.10	.62	.42	.....
23			4.20	.....	2.80	1.42	1.00	.68	.....	.....
24		1.45	3.90	.....	2.68	1.40	1.05	.72	.....	.....
25		1.58	3.25	4.05	2.72	1.42	.95	.72	.45	.....
26		1.55	3.00	4.40	3.00	1.48	.92	.68	.45	.....
27		1.62	2.98	4.85	2.88	1.38	1.00	.62	.40	.....
28		1.60	2.85	4.88	2.65	1.38	.98	.62	.40	.....
29		1.58	2.70	5.05	2.58	1.50	.92	.62	.42	.....
30		1.52	2.68	5.08	2.40	2.28	.92	.62	.42	.....
31		.....	.....	.....	2.30	2.15	.....	.62	.....	.....
1908.										
1	0.3	.4	1.6	2.8	2.3	1.9	1.1	.5	.35	.....
2	.3	.5	1.9	2.85	2.3	2.4	1.1	.5	.4	.....
3	.3	.5	1.9	2.95	2.2	1.9	.9	.55	.35	.....
4	.25	.5	1.9	2.85	2.2	1.8	.8	.55	.35	.....
5	.....	.5	1.75	2.8	2.05	1.6	.85	.45	.35	.....
6	.....	.55	1.75	3.0	2.0	1.55	.8	.5	.35	.....
7	.....	.6	1.7	2.75	2.0	1.5	.75	.45	.35	.....
8	.....	.5	1.8	2.4	1.8	1.45	.7	.45	.3	.....
9	.....	.6	1.9	3.0	1.7	1.65	.65	.45	.4	.....
10	.....	.65	1.75	3.8	1.75	1.55	.7	.45	.35	.....
11	.3	.8	1.6	3.9	1.9	1.45	.7	.45	.3	.....
12	.3	.85	1.5	3.6	1.8	1.35	.7	.5	.35	.....
13	.3	.9	1.5	3.6	1.75	1.25	.7	.5	.3	.....
14	.3	1.1	1.4	3.6	1.7	1.35	.65	.55	.25	.....
15	.3	1.2	1.4	3.55	1.7	1.35	.65	.5	.25	.....
16	.3	1.3	1.8	3.6	1.7	1.3	.6	.45	.08	.....
17	.3	1.6	2.0	3.6	1.6	1.45	.6	.55	.25	.....
18	.3	1.65	2.5	3.2	1.55	2.05	.65	.55	.2	.....
19	.3	1.7	2.85	2.65	1.45	1.85	.55	.55	.2	.....
20	.3	1.65	3.0	2.7	1.4	1.75	.55	.55	.2	.....
21	.35	1.45	2.5	2.9	1.3	1.6	.55	.5	.2	.....
22	.3	1.35	2.5	2.9	1.3	1.55	.5	.4	.15	.....
23	.3	1.35	2.1	2.9	1.3	1.45	.55	.35	.2	.....
24	.35	1.25	1.9	2.95	1.3	1.4	.55	.4	.2	.....
25	.4	1.2	1.8	3.0	1.4	1.25	.55	.35	.2	.....
26	.4	1.0	2.2	2.85	1.35	1.25	.5	.35	.15	.....
27	.4	.95	2.0	2.8	1.4	1.2	.65	.35	.15	.....
28	.3	1.0	1.95	2.7	1.2	1.2	.55	.35	.25	.....
29	.35	1.0	1.95	2.55	1.2	1.3	.5	.35	.15	.....
30	.4	1.0	2.7	2.5	1.2	1.2	.55	.4	.05	.....
31	.4	.....	2.6	.....	1.6	1.1	.....	.35	.....	.....

NOTE.—Ice March 1 to 10, 1908; readings approximate.

Rating table for Rio Grande near Creede, Colo., for 1907 and 1908.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.10	75	1.00	465	2.20	1,350	3.80	3,285
− .05	86	1.10	520	2.30	1,450	4.00	3,560
.00	97	1.20	575	2.40	1,555	4.20	3,840
.10	121	1.30	635	2.50	1,660	4.40	4,130
.20	147	1.40	700	2.60	1,770	4.60	4,430
.30	175	1.50	770	2.70	1,880	4.80	4,740
.40	205	1.60	840	2.80	1,995	5.00	5,050
.50	240	1.70	915	2.90	2,115	5.20	5,370
.60	280	1.80	995	3.00	2,235	5.40	5,690
.70	320	1.90	1,080	3.20	2,485		
.80	365	2.00	1,165	3.40	2,745		
.90	415	2.10	1,255	3.60	3,015		

[a] For illustration of this rating curve see figure 1, p. 21.

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 17 discharge measurements made during 1907–1909 and is well defined.

Monthly discharge of Rio Grande near Creede, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April 24-30	855	735	810	11,200	
May	3,840	700	1,660	102,000	A.
June	5,180	1,880	3,800	226,000	A.
July	5,690	1,450	3,460	213,000	A.
August	1,530	687	1,020	62,700	A.
September	1,150	425	629	37,400	A.
October	415	288	337	20,700	A.
November	300	205	236	14,000	A.
December 1-15	280	212	239	7,110	A.
The period				694,000	
1908.					
March	205	161	179	11,000	B.
April	915	205	483	28,700	A.
May	2,240	700	1,190	73,200	A.
June	3,420	1,560	2,310	137,000	A.
July	1,450	575	904	55,600	A.
August	1,560	520	795	48,900	A.
September	520	240	313	18,600	A.
October	260	190	226	13,900	A.
November	205	109	163	9,700	B.
The period				397,000	

NOTE.—Discharge for missing days 1907 and 1908 interpolated which may give results slightly too low for June, 1908. No correction made for ice conditions March 1–10, 1908.

RIO GRANDE NEAR DEL NORTE, COLO.

This station, which was established in the fall of 1889, was originally located about 2 miles above Del Norte, and records were taken more or less continuously until May 16, 1908, when a new station was established at the new state highway bridge about 6 miles above Del Norte, near the upper edge of the San Luis Valley. Some inflow

takes place between the two points at certain seasons of the year, so that the mean annual flow at the state bridge is somewhat less than that at the old station.

As the station is above all the important diversions, the records show the amount of water available for irrigation, and also the run-off from a drainage area of 1,400 square miles.

The new station is about 4 miles above the mouth of Los Pinos Creek, below the mouth of Wolf Creek, and about 10 miles below the mouth of the South Fork of the Rio Grande. The old station is just above the mouth of Los Pinos Creek.

The diversions from the Rio Grande and its tributaries above this point are all small and are used chiefly for meadow irrigation. They represent a very small percentage of the total flow of the stream. The largest ditch takes water out at Del Norte, about 2 miles below the original station. From this canal and many others diverted at various points nearly 300,000 acres of land in Colorado are now being irrigated from the Rio Grande.

Numerous small storage reservoirs under construction or in contemplation on the tributaries of the Rio Grande will store a large proportion of flood waters, but all the waters of the upper Rio Grande have been filed upon.

The flow of the stream is effected by ice for three or four months during the winter.

Practically no change was made in the datum of the gage at the old station during its maintenance, and this old gage is still being used by the water commissioner in that irrigation district of the State. The present chain gage is located on the highway bridge, and the readings have no determined relation to those taken at the old gage.

Very good results can be obtained at the present station except when ice conditions prevail.

Discharge measurements of Rio Grande near Del Norte, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 16 [a]	W. B. Freeman	144	355	2.27	1,370
June 11 [a]	J. B. Stewart	156	720	4.70	4,710
May 16 [b]	W. B. Freeman	174	463	2.32	1,450
June 11 [b]	J. B. Stewart	188	722	3.75	3,910
July 13 [b]	....do	176	471	1.95	1,320
Nov. 17 [b]	W. B. Freeman	145	213	*c*.60	163

[a] Measurements made at old cable station.
[b] Measurements made at new state bridge, 3 miles above cable station.
[c] Gage at old cable station read 0.70 foot.

Daily gage height, in feet, of Rio Grande near Del Norte, Colo., for 1908.

[James G. Duncan, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.1	2.5	1.9	1.2	0.9	0.8	
2		2.6	3.1	2.4	2.15	1.15	.9	.8	
3			3.2	2.25	2.2	1.15	.9	.8	
4			3.25	2.2	2.0	1.1	.9	.75	
5		2.0	3.1	2.2	1.85	1.1	.9	.75	
6			3.1	2.15	1.85	1.05	.9	.75	
7		2.1	3.0	2.05	1.75	1.0	.85	.75	
8			2.8	2.05	1.85	1.0	.85	.8	
9			3.0	1.95	1.7	.95	.85	.8	
10			3.5	1.9	1.6	.95	.85	.75	
11			3.85	1.9	1.6	.95	.8	.7	
12			3.75	1.95	1.55	.95	.8	.65	
13		2.1	3.7	1.9	1.45	.9	.8	.7	
14			3.65	1.85	1.5	.95	.8	.7	
15			3.65	1.9	1.55	.95	.75	.6	
16	2.1	2.3	3.7	1.95	1.5	.95	.75	.65	
17		2.6	3.65	1.9	1.65	.9	.8	.65	
18	2.3	2.85	3.3	1.8	2.1	.85	.85	.65	
19		3.3	2.95	1.75	2.05	.85	.9	.65	
20		3.5	2.9	1.65	1.95	.8	.85	.65	
21	2.1	2.9	2.9	1.6	1.9	.8	.85	.65	
22		2.95	3.0	1.6	1.75	.85	.85	.7	
23		2.8	2.95	1.6	1.8	.85	.75	.65	
24		2.5	2.9	1.6	1.65	.85	.75	.65	
25	2.0	2.4	2.95	1.6	1.55	.85	.85	.65	
26		2.5	3.5	1.6	1.55	1.05	.8	.65	
27		2.5	3.3	1.55	1.55	.95	.75	.6	
28	1.8	2.4	3.25	1.5	1.45	.95	.8	.6	
29		2.35	2.85	1.4	1.4	.9	.8	.7	
30	1.9	2.7	2.7	1.4	1.3	.9	.8	.7	
31		3.2		1.65	1.3		.8		

NOTE.—Gage heights April 16 to May 13 refer to old gage at cable station; from May 16 to November 30 they refer to new gage at state bridge.

Rating tables for Rio Grande near Del Norte, Colo.

JANUARY 1, 1906, TO MAY 15, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	840	2.10	1,120	2.40	1,435
1.90	930	2.20	1,220	2.50	1,550
2.00	1,025	2.30	1,325	2.60	1,670

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1906 and 1908, and is well defined. This table applies only to the old cable station gage.

MAY 16, 1908, TO NOVEMBER 30, 1908.

0.60	160	1.80	1,005	3.00	2,520
.70	205	1.90	1,100	3.10	2,690
.80	255	2.00	1,200	3.20	2,870
.90	310	2.10	1,305	3.30	3,060
1.00	370	2.20	1,415	3.40	3,250
1.10	435	2.30	1,530	3.50	3,440
1.20	505	2.40	1,650	3.60	3,630
1.30	580	2.50	1,770	3.70	3,830
1.40	660	2.60	1,900	3.80	4,030
1.50	740	2.70	2,040	3.90	4,230
1.60	825	2.80	2,190		
1.70	915	2.90	2,350		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908-9 and is well defined. This table applies only to the new gage at the state bridge.

Monthly discharge of Rio Grande near Del Norte, Colo., for 1908.

[Drainage area, 1,400 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April 16–30	1,320	840	1,060	0.757	0.42	31,600	B.
May	3,440	1,020	1,690	1.21	1.40	104,000	A.
June	4,130	2,040	2,930	2.09	2.33	174,000	A.
July	1,770	660	1,070	.764	.88	65,800	A.
August	1,420	580	931	.665	.77	57,200	A.
September	505	255	345	.246	.27	20,500	A.
October	310	230	271	.194	.22	16,700	A.
November	255	160	205	.146	.16	12,200	A.
The period						482,000	

RIO GRANDE NEAR LOBATOS, COLO.

This station was established June 28, 1899, at the state bridge about 15 miles east of Antonito, in T. 33 N., R. 11 E.

The station is particularly important because it is located only a few miles above the Colorado-New Mexico line, and the records show the amount of water passing from Colorado into New Mexico. The data are valuable also in connection with the proposed Engle reservoir of the United States Reclamation Service, and they will be used in the adjudication of all water rights along the Rio Grande which must eventually be made.

Conejos River enters about 7 miles above the station. A large part of the normal flow of the river is diverted above this station during the irrigation period. About 450,000 acres of land are irrigated, and more will be put under water in connection with some of the proposed reservoir systems above.

Ice usually forms on the river at this point for about three months during the winter, but occasionally open-water conditions prevail through part of this period.

The datum of the gage has not been changed since the station was established. Very good results have been obtained at this station. The river channel is quite permanent, being a gash cut in the lava rock. Occasionally during low water, some sediment is deposited, but it is scoured out in times of flood.

Discharge measurements of Rio Grande near Lobatos, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 23	R. I. Meeker	242	823	3.70	2,570
May 14	W. B. Freeman	242	764	3.42	2,180
June 12	Freeman and Chatfield	255	1,510	6.35	6,640
July 31	W. B. Freeman	246	831	3.76	2,720
October 8	J. B. Stewart	238	424	2.12	635
1908.					
March 28	J. B. Stewart	233	449	2.20	711
May 19	W. B. Freeman	236	473	2.35	803
June 10	J. B. Stewart	233	474	2.26	765
July 12	do	216	304	1.45	240
October 8[a]	Thomas Grieve, jr		126	1.50	236
December 2[b]	J. B. Stewart	132	111	2.20	243

[a] Made by wading above gage.
[b] Made by wading below bridge; ice conditions.

Daily gage height, in feet, of Rio Grande near Lobatos, Colo., for 1907 and 1908.

[Román Mondragón, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	2.3	2.2	2.1	2.5	3.2	4.7	6.7	3.55	3.75	2.1	2.0	1.8
2	2.3	2.2	2.1	2.5	3.3	4.5	6.85	3.4	3.8	2.1	2.0	1.8
3	2.3	2.2	2.1	2.45	3.3	4.4	7.0	3.5	3.55	2.1	2.0	1.8
4	2.3	2.2	2.1	2.3	3.15	4.75	6.95	3.6	3.25	2.1	2.0	1.8
5	2.3	2.2	2.05	2.45	3.0	5.1	6.85	3.65	3.15	2.1	2.0	1.8
6	2.3	2.2	2.05	2.6	3.15	5.45	6.65	3.45	3.0	2.1	2.0	1.7
7	2.3	2.2	2.1	2.6	3.05	5.65	6.5	3.3	2.95	2.2	2.0	1.7
8	2.3	2.2	2.1	2.4	2.95	5.95	6.4	3.2	2.9	2.15	1.9	1.7
9	2.3	2.2	2.1	2.55	2.9	6.2	6.35	3.15	2.8	2.15	1.9	1.7
10	2.3	2.2	2.0	2.8	2.9	6.3	6.15	3.05	2.7	2.15	1.9	1.7
11	2.3	2.2	2.0	2.95	2.9	6.3	5.95	3.0	2.7	2.1	1.9	1.7
12	2.3	2.2	2.1	3.2	3.0	6.32	5.75	2.9	2.6	2.1	1.9	1.7
13	2.3	2.2	2.1	3.6	3.1	6.15	5.50	2.8	2.55	2.1	1.9	1.8
14	2.3	2.2	2.1	4.05	3.3	6.15	5.30	2.8	2.5	2.1	1.9	2.45
15	2.3	2.2	2.1	4.3	3.3	6.35	5.55	3.15	2.4	2.0	1.9	2.4
16	2.3	2.2	2.0	4.5	3.15	6.7	5.65	3.25	2.4	2.0	1.9	2.4
17	2.3	2.2	2.0	4.4	3.15	6.8	5.6	3.1	2.4	2.0	1.9	2.4
18	2.3	2.2	2.1	4.3	3.45	6.8	5.35	3.0	2.4	2.0	1.95	2.4
19	2.3	2.2	2.1	4.2	3.85	6.8	5.0	2.9	2.4	2.0	1.9	2.4
20	2.3	2.2	2.25	4.05	4.1	6.94	4.55	2.9	2.4	2.0	1.9	2.4
21	2.3	2.2	2.7	3.8	4.8	6.89	4.3	2.9	2.5	2.0	1.9	2.4
22	2.3	2.2	2.95	3.8	5.25	6.69	4.2	3.0	2.4	2.0	1.9	2.4
23	2.3	2.2	3.0	3.65	5.75	6.44	4.2	3.0	2.4	2.0	2.0	2.4
24	2.3	2.2	3.0	3.5	6.15	6.19	3.95	2.9	2.35	2.0	1.95	2.4
25	2.3	2.2	2.9	3.35	6.4	6.04	3.6	2.8	2.3	2.0	1.9	2.4
26	2.3	2.2	2.85	3.1	6.35	6.04	3.6	2.7	2.3	2.0	1.9	2.4
27	2.3	2.1	2.75	3.0	6.05	6.24	3.85	2.8	2.3	2.0	1.8	2.4
28	2.3	2.1	2.7	2.95	5.45	6.33	4.05	2.9	2.3	2.0	1.8	2.4
29	2.3	.....	2.65	2.9	5.05	6.48	4.05	2.95	2.3	2.0	1.8	2.4
30	2.3	.....	2.6	3.0	4.8	6.58	3.9	3.1	2.15	2.0	1.8	2.4
31	2.3	.....	2.55	.....	4.75	.....	3.75	3.3	.....	2.0	.....	2.4
1908.[b]												
1	.....	.....	1.95	2.1	1.95	2.1	2.55	1.0	2.1	1.5	1.8	.....
2	.....	.....	2.0	2.1	2.1	2.1	2.35	1.5	2.0	1.55	1.75	.....
3	.....	.....	2.05	2.1	2.2	2.25	2.2	2.1	1.9	1.5	1.7	.....
4	.....	.....	2.1	2.0	2.3	2.4	2.2	2.55	1.85	1.5	1.7	.....
5	.....	.....	2.15	2.0	2.45	2.4	2.05	2.1	1.8	1.5	1.7	.....
6	.....	.....	2.2	1.95	2.3	2.3	2.0	1.95	1.8	1.5	1.7	.....
7	.....	.....	2.2	1.95	2.25	2.35	1.85	1.9	1.7	1.5	1.65	.....
8	.....	.....	2.15	1.9	2.1	2.25	1.8	1.8	1.7	1.5	1.55	.....
9	.....	.....	2.1	1.9	2.1	2.2	1.7	1.8	1.7	1.5	1.45	.....
10	.....	.....	2.0	1.9	2.2	2.3	1.55	1.8	1.6	1.55	1.4	.....

[a] Ice conditions probably prevailed December 14 to 31, 1907. It is not known to what extent they may have prevailed during the early part of the year.
[b] Probable ice conditions November 18–30, 1908.

Daily gage height, in feet, of Rio Grande near Lobatos, Colo., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
11			2.0	1.9	2.15	2.45	1.5	1.75	1.6	1.55	1.4	
12			2.0	1.9	2.1	2.85	1.4	1.6	1.6	1.55	1.3	
13			2.0	1.9	2.0	3.25	1.25	1.65	1.6	1.55	1.3	
14			2.05	1.95	2.0	3.4	1.25	1.6	1.55	1.5	1.2	
15			2.05	2.0	2.0	3.4	1.4	1.65	1.5	1.5	1.25	
16			2.1	2.1	1.95	3.35	1.65	1.75	1.5	1.5	1.3	
17			2.1	2.2	2.0	3.25	1.85	1.9	1.5	1.5	1.45	
18			2.2	2.25	2.15	2.95	1.8	1.9	1.5	1.55	1.7	
19			2.25	2.4	2.45	2.85	1.6	2.05	1.5	1.6	1.7	
20			2.4	2.4	2.65	2.75	1.4	2.35	1.5	1.6	1.7	
21			2.4	2.4	2.85	2.55	1.5	2.55	1.5	1.6	1.7	
22			2.3	2.35	2.7	2.35	1.4	2.7	1.5	1.6	1.6	
23			2.3	2.3	2.6	2.2	1.3	2.7	1.45	1.6	1.6	
24			2.3	2.4	2.5	2.2	1.3	2.6	1.4	1.6	1.6	
25			2.3	2.4	2.5	2.2	1.2	2.5	1.4	1.6	1.65	
26			2.3	2.3	2.5	2.2	1.1	2.45	1.5	1.7	1.6	
27			2.3	2.1	2.4	2.25	1.05	2.4	1.5	1.7	1.7	
28			2.3	2.1	2.25	2.85	1.0	2.3	1.45	1.75	1.7	
29			2.2	2.0	2.0	3.0	1.0	2.2	1.5	1.75	1.9	
30			2.2	1.8	2.0	2.8	1.0	2.15	1.5	1.8	1.9	
31			2.2		2.0		1.0	2.1		1.85		

NOTE.—Probable ice conditions November 18–30, 1908.

Rating tables for Rio Grande near Lobatos, Colo.

JANUARY 1, 1905, TO APRIL 16, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	475	2.60	1,000	3.20	1,710	3.80	2,580
2.10	550	2.70	1,110	3.30	1,840	3.90	2,740
2.20	630	2.80	1,230	3.40	1,980	4.00	2,900
2.30	715	2.90	1,350	3.50	2,120	4.20	3,240
2.40	805	3.00	1,470	3.60	2,270	4.40	3,590
2.50	900	3.10	1,590	3.70	2,420	4.60	3,950

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905–6 and is well defined.

APRIL 17, 1907, TO DECEMBER 31, 1908.

1.00	63	2.20	705	3.40	2,150	5.00	4,700
1.10	91	2.30	800	3.50	2,300	5.20	5,080
1.20	125	2.40	900	3.60	2,450	5.40	5,470
1.30	163	2.50	1,000	3.70	2,600	5.60	5,870
1.40	205	2.60	1,110	3.80	2,750	5.80	6,280
1.50	250	2.70	1,230	3.90	2,900	6.00	6,700
1.60	295	2.80	1,350	4.00	3,060	6.20	7,120
1.70	345	2.90	1,470	4.20	3,380	6.40	7,540
1.80	400	3.00	1,600	4.40	3,700	6.60	7,960
1.90	460	3.10	1,730	4.60	4,020	6.80	8,380
2.00	530	3.20	1,870	4.80	4,360	7.00	8,800
2.10	615	3.30	2,010				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907–8, and is well defined above gage height 1.4 feet.

Monthly discharge of Rio Grande near Lobatos, Colo., for 1907 and 1908.

[Drainage area, 7,700 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	715	715	715	0.093	0.11	44,000	B.
February	630	550	624	.081	.08	34,700	B.
March	1,470	475	779	.101	.12	47,900	B.
April	3,770	715	1,960	.255	.28	117,000	A.
May	7,540	1,470	3,270	.425	.49	201,000	A.
June	8,670	3,700	6,900	.896	1.00	411,000	B
July	8,800	2,450	5,440	.706	.81	334,000	B.
August	2,520	1,230	1,740	.226	.26	107,000	A.
September	2,750	660	1,230	.160	.18	73,200	A.
October	705	530	576	.075	.09	35,400	A.
November	530	390	473	.061	.07	27,900	A.
December	390	335	358	.047	.05	21,800	C.
The year	8,800	335	2,000	.260	3.54	1,450,000	
1908.							
March	900	495	678	.088	.10	41,700	A.
April	900	400	629	.082	.09	37,400	A.
May	1,410	495	765	.099	.11	47,000	A.
June	2,150	615	1,150	.149	.17	68,400	A.
July	1,060	63	316	.041	.05	19,400	A.
August	1,230	63	624	.081	.09	38,400	A.
September	615	205	306	.040	.05	18,200	A.
October	430	250	289	.038	.04	17,800	A.
November	400	125	250	.032	.04	14,900	C.
The period						303,000	

NOTE.—Open-channel flow assumed January to March, 1907. Discharge December 14 to 31, 1907, estimated 350 second-feet; November 18 to 30, 1908, estimated 240 second-feet.

RIO GRANDE NEAR SAN MARCIAL, N. MEX.

A station was established near San Marcial, N. Mex., August 8, 1889, and a measurement was made which gave a discharge of 19 second-feet; but soon after this date the river gage was destroyed and the locality was abandoned until January 29, 1895, when the station was reestablished at the bridge of the Atchison, Topeka and Santa Fe Railway 1 mile south of San Marcial, N. Mex.

The channel is sandy and shifting. A number of bridge piers interfere with the current to a certain extent and sometimes affect the discharge measurements, but they do not affect the observed gage heights. Measurements are made frequently in order to determine closely the daily flow. There is no overflow channel beyond the bridge. The section gives gravity flow. The range between high and low water is about 8 feet.

The inclined gage established January 29, 1895, was carried away in 1896 and a wire gage was put in its place. This gage has since been abandoned and the gage heights are now measured with a graduated rod from the deck of the bridge, but using the old gage datum.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1907.

[By Geo. W. King and D. H. Armstrong.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	248	8.4	1,033	July 6	1,347	10.3	7,529
January 6	183	8.0	683	July 9	1,309	10.0	7,732
January 9	321	8.4	901	July 12	1,196	9.7	6,027
January 12	251	8.4	1,139	July 15	1,073	9.4	5,462
January 15	237	8.3	970	July 18	1,027	9.5	5,106
January 18	338	8.7	1,423	July 21	888	9.2	4,111
January 21	278	8.3	1,130	July 24	677	8.7	3,273
January 24	249	8.3	772	July 27	754	8.9	3,138
January 27	212	8.3	860	July 29	755	9.1	3,244
January 30	331	8.6	970	July 31	597	8.6	2,555
February 2	298	8.7	1,110	August 3	600	8.9	2,595
February 5	313	8.7	1,350	August 6	600	8.8	2,780
February 8	346	8.6	1,187	August 9	524	8.6	2,152
February 11	350	8.7	1,227	August 12	410	8.3	1,698
February 14	353	8.6	1,062	August 15	306	8.2	1,139
February 17	292	8.5	1,106	August 18	246	8.0	950
February 20	362	8.7	1,190	August 21	564	9.1	2,410
February 23	391	8.8	1,305	August 23	815	9.5	4,066
February 26	376	8.8	1,456	August 26	514	9.0	2,171
February 28	290	8.7	1,400	August 27	1,064	10.4	5,540
March 3	275	8.6	1,239	August 30	1,120	10.6	5,701
March 6	245	8.6	952	September 1	2,033	12.0	11,458
March 9	194	8.6	903	September 4	856	9.8	3,962
March 12	273	8.7	1,190	September 7	591	9.7	2,591
March 15	312	8.8	1,147	September 10	362	9.3	1,921
March 18	178	8.4	713	September 13	328	9.4	1,476
March 21	262	8.6	1,135	September 16	416	9.4	1,442
March 23	507	9.35	2,425	September 19	457	9.6	2,064
March 26	658	9.5	2,981	September 21	1,174	10.7	5,276
March 29	429	8.9	2,480	September 22	1,463	11.7	6,871
March 31	501	9.0	2,181	September 25	497	9.1	1,649
April 3	495	9.0	1,856	September 28	280	9.0	1,082
April 6	483	9.0	1,918	September 30	309	9.2	1,000
April 9	435	9.0	2,160	October 3	297	9.1	760
April 12	500	9.0	1,878	October 6	280	9.2	794
April 14	756	9.8	3,754	October 9	303	9.3	829
April 16	1,257	10.7	5,810	October 12	188	9.2	814
April 19	1,122	10.4	5,708	October 15	237	9.4	894
April 24	983	9.7	4,954	October 18	241	9.5	988
April 27	872	9.4	4,041	October 21	255	9.6	893
April 30	1,018	9.7	3,871	October 24	419	9.9	1,591
May 3	1,028	9.7	4,743	October 27	305	9.3	1,450
May 6	947	9.7	4,339	October 30	283	9.2	1,416
May 9	923	9.55	3,904	November 2	264	9.2	1,189
May 12	827	9.4	3,854	November 5	210	9.3	984
May 15	900	9.7	4,269	November 8	214	9.3	868
May 18	779	9.7	4,093	November 11	200	9.3	859
May 21	1,073	10.0	5,164	November 14	230	9.3	913
May 22	1,269	10.7	6,318	November 17	260	9.5	1,009
May 25	1,837	11.4	9,358	November 20	217	9.4	905
May 28	1,716	11.3	11,067	November 23	222	9.6	998
May 31	1,710	11.1	9,697	November 26	249	9.5	948
June 3	1,554	10.3	7,406	November 29	225	9.5	700
June 7	1,620	10.3	8,804	December 2	227	9.6	817
June 9	1,694	10.9	9,660	December 5	223	9.6	828
June 12	1,698	10.7	9,344	December 8	212	9.5	824
June 15	1,824	10.5	9,508	December 12	203	9.6	831
June 18	1,598	10.9	9,342	December 15	177	9.5	678
June 20	1,765	11.3	10,218	December 18	142	9.3	602
June 21	2,051	11.6	11,679	December 21	164	9.4	586
June 24	1,698	10.5	9,207	December 24	200	9.5	617
June 27	1,419	10.2	7,652	December 27	216	9.6	738
June 30	1,296	9.7	7,148	December 30	210	9.5	599
July 3	1,322	10.0	7,318				

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1908.

[By G. W. King.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	235	9.7	854	June 21	464	10.4	1,942
January 5	249	9.8	922	June 24	263	10.0	1,284
January 8	274	9.8	723	June 27	217	9.8	794
January 11	195	9.7	648	June 30	149	9.5	537
January 14	200	9.7	654	July 3	218	9.9	891
January 17	184	9.8	687	July 6	170	9.7	648
January 20	181	9.8	736	July 9	185	9.9	905
January 23	157	9.7	663	July 12	71	9.1	229
January 26	200	9.7	581	July 15	155	9.65	536
January 30	245	9.7	686	July 17	266	10.2	1,366
February 2	180	9.6	710	July 20	351	10.2	1,503
February 5	170	9.6	631	July 23	151	9.0	522
February 8	217	10.0	810	July 26	216	9.5	803
February 11	172	9.5	620	July 29	320	9.8	983
February 14	194	9.7	759	July 31	212	9.5	565
February 17	160	9.7	566	August 3	167	9.5	569
February 20	167	9.7	606	Do	780	11.4	3,462
February 23	223	9.9	731	August 5	379	10.6	2,330
February 26	395	10.4	1,598	August 8	133	9.2	474
February 29	271	9.7	1,029	August 9	839	12.3	4,987
March 3	291	10.2	1,291	August 12	230	9.8	961
March 6	211	9.6	1,009	August 15	526	11.4	2,942
March 10	329	10.0	1,321	August 18	427	10.5	1,540
March 13	241	9.7	945	August 21	228	10.1	870
March 16	253	9.5	1,097	August 24	439	10.6	1,508
March 19	405	10.2	1,803	August 28	377	11.0	1,662
Marrh 22	397	10.4	1,737	August 31	184	10.2	968
March 25	376	10.0	1,504	September 3	157	10.1	586
March 28	276	9.9	1,192	September 6	143	9.9	374
March 31	307	9.9	1,231	September 9	123	9.8	218
April 3	332	9.7	795	September 12	63	9.4	103
April 6	354	9.7	865	September 15	32	9.1	35
April 9	329	9.9	1,093	October 22	7	9.2	7
April 12	387	10.1	1,648	October 25	37	9.4	71
April 15	377	10.2	1,978	October 28	107	9.9	203
April 19	881	11.5	4,695	October 31	127	10.0	283
April 22	615	10.5	3,567	November 3	206	10.2	431
April 25	817	10.8	3,254	November 6	199	10.3	513
April 28	579	10.5	2,832	November 9	192	10.3	494
April 30	472	10.2	2,154	November 12	176	10.3	515
May 3	426	10.1	1,578	November 15	183	10.3	560
May 6	611	10.9	3,862	November 18	144	10.2	459
May 9	393	10.1	2,104	November 21	121	10.1	373
May 12	397	10.4	2,113	November 24	128	10.0	419
May 15	477	10.6	2,409	November 27	189	10.5	672
May 18	636	10.6	2,413	November 30	212	10.5	757
May 22	719	11.1	3,625	December 3	204	10.5	694
May 25	854	11.1	4,045	December 6	230	10.6	818
May 28	677	10.8	3,263	December 9	210	10.5	786
May 31	483	10.3	2,189	December 12	179	10.4	576
June 3	436	10.3	1,918	December 15	264	10.5	546
June 6	531	10.4	1,813	December 18	163	10.5	569
June 9	542	10.5	1,679	December 21	172	10.5	551
June 12	283	10.2	1,281	December 24	193	10.4	594
June 15	301	10.2	1,201	December 27	279	10.6	712
June 18	470	10.5	2,094	December 30	130	10.3	498

Daily gage height, in feet, of Rio Grande near San Marcial, N. Mex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	8.3	8.7	8.7	8.9	9.75	10.8	9.9	8.85	11.75	9.15	9.4	9.6
2	8.3	8.65	8.6	9.0	9.7	10.65	9.95	8.7	10.3	9.15	9.25	9.6
3	8.4	8.8	8.6	8.9	9.65	10.25	10.0	8.9	9.9	9.1	9.1	9.6
4	8.4	8.8	8.5	8.85	9.6	10.05	10.05	9.2	9.7	9.1	9.2	9.6
5	8.3	8.7	8.5	8.85	9.7	10.0	10.05	9.0	9.6	9.1	9.3	9.6
6	8.0	8.55	8.6	9.0	9.7	9.9	10.3	8.8	9.8	9.15	9.4	9.6
7	8.15	8.5	8.5	9.2	9.7	10.15	10.2	8.6	9.7	9.1	9.3	9.6
8	8.2	8.6	8.5	9.15	9.65	10.6	10.2	8.85	9.65	9.1	9.3	9.5
9	8.4	8.7	8.6	8.9	9.6	10.9	9.9	8.5	9.45	9.3	9.3	9.5
10	8.4	8.7	8.6	8.8	9.5	10.7	9.85	8.45	9.3	9.1	9.2	9.5
11	8.4	8.7	8.7	9.05	9.4	10.65	9.85	8.3	9.3	9.1	9.3	9.5
12	8.4	8.6	8.7	8.95	9.4	10.6	9.7	8.3	9.5	9.2	9.35	9.6
13	8.3	8.55	8.6	9.2	9.4	10.65	9.7	8.3	9.4	9.35	9.4	9.6
14	8.3	8.6	8.75	9.6	9.6	10.6	9.45	8.3	9.35	9.4	9.3	9.6
15	8.3	8.5	8.8	10.0	9.7	10.5	9.4	8.2	9.5	9.4	9.3	9.55
16	8.3	8.55	8.7	10.6	9.65	10.5	9.5	8.15	9.35	9.45	9.4	9.5
17	8.3	8.5	8.55	10.6	9.7	10.55	9.5	8.05	9.5	9.5	9.45	9.5
18	8.55	8.6	8.4	10.65	9.65	10.8	9.5	8.0	9.5	9.5	9.5	9.3
19	8.65	8.6	8.35	10.4	9.7	11.0	9.4	8.3	9.7	9.5	9.5	9.3
20	8.5	8.7	8.5	10.4	10.0	11.25	9.35	8.55	10.2	9.7	9.4	9.25
21	8.3	8.8	8.6	10.5	10.1	11.6	9.2	9.0	10.4	9.6	9.45	9.4
22	8.3	8.85	8.6	10.6	10.7	11.3	9.2	9.6	11.05	9.45	9.6	9.5
23	8.4	8.8	9.3	10.0	11.0	10.9	9.1	9.3	9.65	9.4	9.6	9.5
24	8.3	8.7	9.45	9.7	11.3	10.6	8.65	8.9	9.2	10.3	9.6	9.5
25	8.4	8.8	9.45	9.75	11.3	10.45	8.6	9.05	9.15	9.9	9.6	9.5
26	8.55	8.8	9.45	9.6	11.6	10.35	8.9	9.0	9.0	10.05	9.5	9.5
27	8.3	8.7	9.3	9.3	11.3	10.1	8.85	10.2	9.0	9.5	9.5	9.6
28	8.3	8.7	9.1	9.1	11.4	9.85	9.1	9.65	9.0	9.4	9.5	9.7
29	8.55	.....	9.05	9.25	11.35	9.85	9.2	9.4	9.05	9.2	9.5	9.7
30	8.6	.....	9.25	9.65	11.4	9.75	8.7	10.05	9.2	9.25	9.5	9.55
31	8.65	.....	9.05	.....	11.1	.....	8.55	12.05	.....	9.0	.....	9.5
1908.												
1	9.5	9.8	9.7	9.9	10.2	10.3	9.65	9.65	10.2	.....	10.1	10.4
2	9.65	9.65	10.15	9.65	10.2	10.45	9.5	9.6	10.1	.....	10.1	10.5
3	9.7	9.6	10.2	9.7	10.1	10.3	9.95	10.8	10.1	.....	10.2	10.5
4	9.7	9.7	9.9	9.7	10.3	10.3	9.75	10.4	10.0	.....	10.2	10.6
5	9.8	9.6	9.8	9.7	10.8	10.4	9.8	10.8	10.1	.....	10.3	10.5
6	9.9	9.75	9.6	9.65	10.95	10.4	9.7	10.25	9.9	.....	10.3	10.6
7	9.8	9.8	9.6	9.5	10.55	10.4	9.7	9.6	9.8	.....	10.3	10.5
8	9.8	9.95	9.6	9.6	10.3	10.4	9.7	9.25	9.7	.....	10.3	10.4
9	9.7	9.75	9.6	9.8	10.1	10.5	9.8	10.7	9.8	.....	10.3	10.5
10	9.7	9.55	9.9	10.0	10.2	10.4	9.55	10.7	9.7	.....	10.3	10.5
11	9.7	9.5	9.7	10.15	10.2	10.3	9.45	10.1	9.5	.....	10.3	10.4
12	9.7	9.5	9.7	10.1	10.35	10.2	9.15	9.8	9.4	.....	10.3	10.4
13	9.6	9.55	9.7	10.0	10.4	10.2	9.1	9.95	9.3	.....	10.3	10.4
14	9.7	9.65	9.55	10.1	10.45	10.2	9.1	9.85	9.3	.....	10.3	10.5
15	9.8	9.7	9.5	10.2	10.6	10.2	9.35	10.75	9.15	.....	10.3	10.5
16	9.7	9.85	9.5	10.1	10.45	10.25	9.45	11.35	8.95	.....	10.3	10.45
17	9.8	9.75	9.5	10.2	10.4	10.45	10.6	10.95	8.75	.....	10.2	10.55
18	9.8	9.6	9.7	10.4	10.5	10.45	10.85	10.6	.....	.....	10.2	10.5
19	9.8	9.6	10.1	11.2	10.6	10.6	10.0	10.6	.....	.....	10.2	10.45
20	9.8	9.7	10.2	10.85	10.6	10.45	10.5	10.4	.....	.....	10.1	10.4
21	9.8	9.9	10.55	10.7	10.65	10.4	9.7	10.15	.....	.....	10.1	10.45
22	9.75	9.9	10.3	10.5	11.1	10.4	9.4	10.25	.....	9.2	10.2	10.55
23	9.7	9.9	10.2	10.4	11.1	10.15	9.1	10.35	.....	9.25	10.15	10.5
24	9.7	10.2	10.2	10.5	10.9	10.0	9.0	10.55	.....	9.3	10.05	10.4
25	9.7	10.35	10.0	10.8	11.0	9.9	9.05	10.75	.....	9.4	10.05	10.4
26	9.7	10.4	9.9	10.75	11.0	9.8	9.3	10.7	.....	9.55	10.1	10.4
27	9.7	10.25	9.8	10.8	10.85	9.8	9.45	10.7	.....	9.75	10.35	10.55
28	9.8	10.35	9.9	10.55	10.8	9.7	9.65	10.9	.....	9.9	10.5	10.45
29	9.8	9.85	9.9	10.35	10.8	9.6	9.9	10.65	.....	9.9	10.6	10.35
30	9.7	.....	9.9	10.2	10.7	9.5	9.6	10.5	.....	10.0	10.5	10.3
31	9.8	.....	9.9	.....	10.35	.....	9.5	10.25	.....	10.0	.....	10.4

NOTE.—No flow September 18–October 21, 1908.

Daily discharge, in second-feet, of Rio Grande near San Marcial, N. Mex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1,010	1,080	1,390	1,950	4,260	8,840	7,260	2,810	a10,610	905	1,440	815
2	980	a1,060	1,250	1,960	4,450	8,410	7,290	2,420	5,660	855	1,230	a815
3	a1,035	1,290	a1,240	a1,740	a 4,640	a 7,330	a7,320	a2,590	4,300	a760	1,010	820
4	1,035	1,370	1,040	1,700	4,410	7,010	7,350	3,200	a 3,760	760	1,000	825
5	945	a1,350	950	1,720	4,470	6,930	7,350	2,990	3,170	760	a 985	a 830
6	a 685	1,180	a 950	a1,920	a 4,340	6,770	a7,530	a2,780	3,180	a 775	1,020	840
7	765	1,110	840	2,320	4,340	a 8,040	7,600	2,360	a 2,590	760	905	850
8	795	a1,190	820	2,320	4,190	9,240	7,860	2,650	2,510	760	a 870	a 825
9	a 900	1,230	a900	a2,000	a 4,050	a 9,660	a7,530	a2,000	2,170	a 830	865	815
10	980	1,230	960	1,790	3,890	9,340	7,060	1,920	a 1,920	800	780	810
11	1,060	a1,230	1,130	2,040	3,770	9,260	6,700	1,700	1,710	800	a 860	800
12	a1,140	1,100	a1,190	a1,810	a 3,850	a 9,140	a6,030	a1,700	1,890	a 815	915	a 830
13	1,030	1,030	1,030	2,350	3,850	9,430	6,030	1,560	a 1,480	875	975	805
14	1,000	a1,060	1,140	a3,280	4,130	9,520	5,560	1,430	1,360	895	a 915	785
15	a 970	1,020	a1,150	4,210	a 4,270	a 9,510	a5,460	a1,140	1,650	a 895	915	a 720
16	970	1,100	1,040	a5,580	4,110	9,190	5,460	1,090	a 1,340	940	960	680
17	970	a1,110	870	5,780	4,150	8,960	5,280	990	1,720	a 990	a 985	680
18	a1,255	1,150	a 710	6,200	a 3,920	a 9,120	a5,110	a 950	1,790	990	1,010	a 600
19	1,385	1,150	740	a5,710	4,090	9,560	4,770	1,350	a 2,360	990	1,010	585
20	1,275	a1,190	960	6,450	5,160	a10,110	4,610	1,680	3,820	1,190	a 905	545
21	a1,130	1,300	a1,130	7,500	a 5,340	a11,680	a4,110	a2,280	a 4,400	a 895	930	a 585
22	1,010	1,360	1,250	7,500	a 6,320	11,000	4,110	3,840	a 5,840	820	1,000	615
23	970	a1,300	a2,350	5,800	7,620	10,100	3,940	a3,670	2,750	a 795	a1,000	615
24	a 770	1,270	2,710	a4,950	8,920	a 9,430	a3,190	2,570	1,850	2,230	1,000	a 615
25	860	1,410	2,790	5,110	a 8,920	8,950	2,960	2,570	a 1,750	1,590	1,000	630
26	995	a1,460	a2,880	4,650	10,860	8,430	3,290	a2,170	1,330	1,740	a 950	645
27	a 860	1,400	2,810	a3,840	10,360	a 7,550	a3,160	a5,050	1,190	a1,520	865	a 740
28	860	1,400	2,650	3,180	a11,470	7,290	3,240	3,960	a 1,080	1,490	780	800
29	950	.....	a2,720	3,230	11,080	7,290	a3,400	3,380	940	1,420	a 700	780
30	a 970	.....	2,810	a3,770	11,090	a 7,190	2,690	a4,600	a 1,000	a1,430	700	a 640
31	1,010	.....	a2,260	.....	a 9,700	.....	a2,490	10,050	.....	1,220	.....	600
1908.												
1	650	815	1,030	1,150	2,030	2,100	670	750	875	.....	355	685
2	a 815	a 750	1,260	825	1,900	2,220	535	690	675	.....	355	715
3	855	685	a1,290	a 795	a 1,580	a 1,920	a 950	a2,540	a 585	.....	a 430	a 695
4	855	740	1,150	820	2,150	1,840	710	2,050	480	.....	430	770
5	a 920	a 630	1,100	840	3,570	1,890	770	a2,620	585	.....	515	745
6	935	705	a1,010	a 815	a 4,000	a 1,810	a 650	1,860	a 375	.....	a 515	a 820
7	790	695	1,010	635	3,090	1,720	650	1,000	270	.....	505	785
8	a 725	a 770	1,010	750	2,540	1,630	650	a 540	165	.....	500	755
9	650	690	1,010	a 980	a 2,100	a 1,680	a 820	a2,660	a 220	.....	a 495	a 785
10	650	600	a1,240	1,340	2,110	1,550	610	2,410	190	.....	500	735
11	a 650	a 620	1,040	1,700	1,960	1,420	525	1,440	130	.....	510	630
12	650	620	990	a1,650	a 2,040	a 1,280	a 270	a 960	a 105	.....	a 515	a 575
13	580	655	a 945	1,490	2,110	1,250	230	1,150	80	.....	530	550
14	a 655	a 725	935	1,730	2,190	1,230	230	1,020	80	.....	545	570
15	710	695	1,000	a1,980	a 2,410	a 1,200	a 370	a2,140	a 45	.....	a 560	a 545
16	630	735	a1,100	1,770	2,180	1,420	415	2,860	25	.....	560	530
17	a 685	a 600	1,170	1,980	2,110	1,870	a1,970	2,240	10	.....	460	585
18	705	510	1,380	2,400	a 2,260	a 2,020	2,390	a1,690	.....	.....	a 460	a 570
19	720	520	a1,730	a4,070	2,410	2,250	1,160	1,710	.....	.....	460	540
20	a 735	a 605	1,800	3,960	2,410	2,020	a1,750	1,370	.....	.....	375	505
21	735	730	2,010	3,790	2,530	a 1,940	1,090	a 950	.....	.....	a 375	a 525
22	700	730	a1,680	a3,570	a 3,620	1,940	845	1,060	.....	a 5	455	590
23	a 665	a 730	1,620	3,160	3,760	1,530	a 600	1,190	.....	25	460	580
24	635	1,230	1,620	3,060	3,420	a 1,280	520	a1,440	.....	40	a 445	a 545
25	610	1,490	a1,500	a3,250	a 3,800	1,080	550	1,570	.....	a 70	445	565
26	a 580	a1,600	1,350	3,180	3,780	890	a 690	1,550	.....	110	470	590
27	605	1,490	1,190	3,250	3,390	a 790	775	1,550	.....	160	a 600	a 690
28	715	1,640	a1,190	a2,900	a 3,260	710	895	a1,620	.....	a 205	700	605
29	740	a1,180	1,200	2,490	3,260	620	a1,120	1,360	.....	205	810	535
30	a 685	.....	1,220	a2,150	3,050	a 535	705	1,230	.....	285	a 755	a 500
31	765	.....	1,230	.....	2,300	.....	565	a1,010	.....	a 285	.....	550

a Dates of measurement.

NOTE.—No flow September 18–October 21, 1908.

Monthly discharge of Rio Grande near San Marcial, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	1,385	685	986	60,635
February	1,460	1,020	1,219	67,696
March	2,880	710	1,505	92,549
April	7,500	1,700	3,745	222,863
May	11,470	3,770	6,001	368,965
June	11,680	6,770	8,809	524,192
July	7,860	2,490	5,346	328,740
August	10,050	950	2,692	165,521
September	10,610	940	2,704	160,899
October	2,230	760	1,048	64,453
November	1,440	700	949	56,489
December	850	545	727	44,707
The year	11,680	545	2,961	2,157,709
1908.				
January	935	580	710	43,636
February	1,640	510	834	47,970
March	2,010	935	1,258	77,375
April	4,070	635	2,083	123,927
May	4,000	1,580	2,688	165,263
June	2,250	535	1,521	90,516
July	2,390	230	796	48,952
August	2,860	540	1,556	95,663
September	875	0	163	9,709
October	285	0	45	2,757
November	810	355	503	29,931
December	820	500	625	38,410
The year	4,070	0	1,065	774,109

RIO GRANDE NEAR EL PASO, TEX.

This station was located at the pumping house of the smelter company, 3 miles north of El Paso, Tex. The bed of the stream at that point is composed of mud, and is constantly shifting and changing. May 1, 1897, the station was placed under the charge of W. W. Follett, consulting engineer, International Boundary Commission, and by him removed 1 mile farther up the river to Courchesne's lime-kiln. Although the section is unstable and subject to overflow, it is still the best site for a station in the vicinity of El Paso, as the entire bed is constantly shifting for many miles above and below. On this account frequent discharge measurements are made in order to closely estimate the daily discharge.

River heights were measured at the masonry pump-foundation pier. As the pier was torn down in October, 1902, an inclined wooden gage was established some 60 feet upstream and later the gage was removed 300 feet downstream.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande near El Paso, Tex., in 1907.

[By W. L. Follett and E. E. Winter.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	358	7.9	941	July 8	1,122	11.3	7,651
January 6	277	7.7	837	July 12	1,082	11.0	6,665
January 9	267	7.5	718	July 15	977	10.8	6,235
January 12	302	7.75	948	July 18	839	10.3	5,134
January 15	413	8.0	1,253	July 22	822	10.25	4,917
January 19	323	8.4	1,399	July 25	755	9.85	4,274
January 22	295	8.1	1,208	July 28	779	9.6	3,966
January 25	241	7.8	961	July 31	832	10.2	4,349
January 29	195	7.6	632	August 3	707	9.15	3,611
January 31	214	7.7	658	August 6	552	9.0	2,476
February 3	384	7.9	916	August 9	524	9.0	2,244
February 6	449	7.95	1,000	August 12	510	8.65	2,163
February 9	394	8.1	918	August 15	373	8.3	1,133
February 12	378	8.05	905	August 18	341	7.8	723
February 15	290	7.9	801	August 21	225	7.95	622
February 18	267	7.85	799	August 24	461	9.4	2,117
February 21	252	7.7	784	August 27	477	9.35	2,284
February 24	275	7.8	751	August 29	696	10.35	3,508
February 28	272	7.85	819	August 31	834	10.95	4,622
March 3	259	8.0	951	September 2	1,324	12.85	8,036
March 6	229	7.85	824	September 3	1,562	13.5	10,562
March 9	177	7.7	585	September 5	821	10.55	4,111
March 12	177	7.6	597	September 8	543	9.55	2,605
March 15	234	7.9	827	September 11	420	9.0	1,835
March 18	246	7.85	882	September 14	414	8.65	1,396
March 21	195	7.4	499	September 17	400	8.5	1,123
March 24	190	7.4	509	September 20	393	8.6	1,360
March 27	512	8.95	2,058	September 23	712	10.1	3,565
March 29	498	9.15	2,377	September 25	475	9.35	2,398
March 31	398	8.9	1,875	September 27	329	8.4	1,303
April 3	363	8.65	1,742	September 30	257	7.8	781
April 6	337	8.45	1,437	October 3	227	7.6	560
April 9	339	8.4	1,414	October 6	243	7.65	531
April 12	332	8.4	1,333	October 9	211	7.55	488
April 15	358	8.3	1,311	October 12	202	7.35	421
April 17	639	9.8	3,351	October 15	220	7.45	489
April 19	1,067	11.15	5,281	October 18	248	7.75	529
April 21	1,084	11.2	6,064	October 21	296	7.85	837
April 24	872	10.85	5,481	October 24	263	7.95	852
April 27	706	9.95	3,747	October 27	362	8.55	1,467
April 30	576	9.45	2,915	October 30	375	8.65	1,488
May 3	835	10.55	4,140	November 3	296	8.1	1,039
May 6	714	10.0	3,723	November 6	270	8.0	927
May 9	645	10.0	3,746	November 9	254	7.85	769
May 12	545	9.4	2,800	November 13	264	7.95	902
May 15	500	9.2	2,468	November 15	240	7.8	752
May 18	615	9.7	3,089	November 18	252	7.95	864
May 21	670	9.65	3,183	November 21	290	8.2	1,106
May 25	938	11.05	5,275	November 24	298	8.1	1,009
May 28	1,143	12.1	7,423	November 27	281	8.1	944
May 30	1,401	12.6	8,993	November 30	266	8.0	759
June 2	1,473	12.55	9,781	December 3	226	7.8	592
June 5	1,098	11.4	7,136	December 6	253	8.0	803
June 8	956	11.2	5,776	December 9	246	7.9	673
June 11	1,113	11.8	6,928	December 12	239	7.9	674
June 14	1,148	11.95	7,515	December 15	259	7.9	658
June 17	1,095	11.95	6,957	December 18	249	7.85	645
June 20	1,269	12.3	8,283	December 21	241	7.95	631
June 22	1,398	12.45	9,024	December 24	224	7.7	563
June 24	1,597	13.05	10,753	December 27	213	7.65	464
June 27	1,207	11.95	7,866	December 30	204	7.6	437
June 30	839	11.1	5,503	December 31	223	7.7	515
July 3	923	10.9	5,262				

Discharge measurements of Rio Grande near El Paso, Tex., in 1908.

[By W. L. Follett, J. D. Dillard, and T. A. Stiles.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 7	209	8.3	814	June 6	220	8.35	898
January 10	214	8.1	666	June 9	204	8.3	808
January 13	204	8.0	528	June 12	189	8.1	663
January 16	172	7.6	385	June 15	126	7.6	363
January 19	176	7.75	432	June 18	108	7.5	218
January 22	191	7.9	519	June 22	232	8.6	932
January 25	198	7.9	504	June 25	184	8.2	557
January 28	166	7.85	484	June 30	95	7.1	129
January 31	188	7.85	456	July 3	35	6.3	37
February 3	178	7.8	436	July 10	6	6.2	3
February 6	200	7.95	494	July 21	325	9.0	1,358
February 9	167	7.9	481	July 24	202	8.3	621
February 12	233	8.2	808	July 27	169	8.2	591
February 15	226	7.9	532	July 30	166	8.0	470
February 18	234	8.0	521	August 2	165	8.05	417
February 21	228	7.95	566	August 5	171	8.15	529
February 24	212	7.85	562	August 7	224	8.7	924
February 27	211	7.9	560	August 8	333	9.4	1,395
February 29	227	8.0	593	August 11	137	7.7	273
March 3	241	8.3	770	August 13	318	9.5	1,504
March 6	249	8.2	784	August 16	229	8.7	872
March 9	251	8.2	523	August 18	414	10.2	1,977
March 12	253	8.2	797	August 21	312	9.1	1,280
March 15	264	8.1	735	August 24	226	8.65	822
March 18	143	7.6	287	August 27	422	10.3	2,038
March 21	129	7.4	281	August 29	192	8.7	627
March 23	391	9.1	1,638	August 31	303	9.3	1,246
March 26	269	8.65	1,120	September 3	163	8.1	389
March 29	214	8.25	778	September 4	631	11.4	3,209
March 31	192	8.0	612	September 7	115	7.7	229
April 3	182	8.1	603	September 10	62	7.2	79
April 6	186	7.9	507	September 13	28	6.7	23
April 9	132	7.5	264	September 16	27	6.5	22
April 12	159	7.7	384	November 14	39	7.2	56
April 15	245	8.5	937	November 17	79	7.2	117
April 18	349	9.0	1,577	November 21	104	7.3	180
April 21	571	10.5	3,323	November 24	112	7.3	157
April 24	485	9.9	2,715	November 29	102	7.35	169
April 27	456	9.8	2,464	December 3	226	8.1	524
April 30	385	9.6	1,876	December 6	176	7.85	331
May 3	303	8.9	1,341	December 10	137	7.5	209
May 6	272	8.7	1,134	December 13	220	8.1	516
May 17	328	9.1	1,616	December 16	149	7.7	256
May 21	250	8.6	1,092	December 19	138	7.5	202
May 24	416	9.7	2,385	December 22	141	7.6	224
May 28	517	10.2	3,090	December 24	138	7.5	205
May 31	429	9.4	2,084	December 27	208	8.0	498
June 3	256	8.65	1,137	December 31	236	8.2	557

NOTE.—No measurements during October, 1908, as there was no flow.

Daily gage height, in feet, of Rio Grande near El Paso, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	7.85	7.7	7.95	8.9	9.45	12.65	10.95	9.3	10.85	7.65	8.35	7.9
2	7.95	7.8	7.9	8.8	9.7	12.3	10.9	9.1	13.0	7.6	8.25	7.9
3	7.9	7.85	8.0	8.65	10.4	12.0	10.8	9.1	13.45	7.6	8.1	7.8
4	8.0	7.9	8.05	8.5	10.4	11.6	10.9	8.95	11.55	7.6	8.3	7.8
5	7.8	7.9	7.85	8.5	10.3	11.35	11.1	8.9	10.3	7.6	8.05	7.85
6	7.7	7.95	7.85	8.45	10.0	10.75	11.2	9.15	10.3	7.65	8.0	7.95
7	7.55	8.25	7.7	8.3	9.9	10.9	11.2	9.65	9.95	7.6	7.95	7.9
8	7.5	8.2	7.7	8.25	9.95	11.2	11.3	9.2	9.6	7.6	7.9	7.9
9	7.5	8.1	7.7	8.35	9.9	11.5	11.3	8.95	9.8	7.5	7.9	7.9
10	7.45	7.9	7.55	8.5	9.85	11.6	11.3	8.9	9.3	7.35	7.85	7.9
11	7.45	7.9	7.5	8.45	9.6	11.75	11.05	8.8	9.0	7.35	7.9	7.9
12	7.7	8.05	7.6	8.4	9.5	11.7	10.95	8.55	8.75	7.35	7.95	7.9
13	7.85	7.95	7.55	8.25	9.45	11.9	11.0	8.4	8.6	7.35	7.9	7.9
14	7.95	8.0	7.65	8.2	9.15	11.85	10.75	8.3	8.6	7.35	7.85	7.8
15	8.05	7.9	7.9	8.25	9.2	11.8	10.8	8.3	8.5	7.4	7.8	7.8
16	8.05	7.75	7.9	8.55	9.3	11.7	10.6	8.1	8.35	7.5	7.9	7.95
17	8.05	7.9	7.9	9.6	9.4	11.95	10.45	7.9	8.3	7.65	8.0	7.9
18	8.9	7.85	7.95	10.4	9.7	11.9	10.3	7.8	8.5	7.7	7.9	7.9
19	8.4	7.8	7.7	11.0	9.8	11.9	10.25	7.8	8.35	7.65	7.95	7.85
20	8.15	7.7	7.45	11.3	9.8	12.25	10.3	8.15	8.75	7.7	8.1	7.95
21	8.15	7.7	7.45	11.2	9.7	12.3	10.4	7.95	8.8	7.8	8.2	7.95
22	8.1	7.65	7.35	11.05	9.9	12.5	10.25	8.3	10.15	8.05	8.25	7.9
23	8.0	7.6	7.3	11.4	10.2	12.5	10.1	8.7	10.5	7.95	8.1	7.7
24	7.9	7.8	7.4	11.05	10.55	13.05	10.05	8.85	10.9	7.95	8.1	7.7
25	7.8	7.75	7.6	10.55	11.15	12.55	9.85	9.8	9.5	8.5	8.0	7.65
26	7.75	7.9	8.75	10.0	11.8	12.1	9.5	9.25	8.8	9.1	8.1	7.65
27	7.65	7.9	8.95	9.95	12.15	11.85	9.4	9.35	8.45	8.55	8.1	7.65
28	7.5	7.85	9.2	9.9	12.2	11.6	9.6	8.9	8.1	9.25	7.95	7.6
29	7.6	.....	9.15	9.75	12.55	11.3	9.4	10.5	7.85	9.0	7.95	7.6
30	7.6	.....	8.95	9.5	12.7	11.0	9.4	11.15	7.8	8.6	8.0	7.65
31	7.7	.....	8.95	.....	12.7	.....	10.2	10.85	.....	8.35	.....	7.85
1908.												
1	8.0	7.7	8.2	8.0	9.3	9.15	6.6	8.4	9.35	.....	.....	8.05
2	7.75	7.8	8.4	8.0	8.95	8.8	6.35	8.0	8.6	.....	.....	8.1
3	7.7	7.8	8.3	8.2	8.9	8.6	6.25	7.65	8.05	.....	.....	8.1
4	7.8	7.85	8.0	8.25	8.9	8.5	.....	8.0	9.7	.....	.....	8.0
5	7.95	8.0	8.0	8.0	8.8	8.5	.....	8.0	9.65	.....	.....	7.9
6	8.2	8.0	8.2	7.95	8.7	8.35	.....	8.7	8.1	.....	.....	7.85
7	8.2	8.1	8.3	7.85	9.2	8.3	.....	9.25	7.65	.....	.....	7.65
8	8.05	8.0	8.3	7.75	10.05	8.4	6.7	9.25	7.6	.....	.....	7.8
9	8.15	7.9	8.3	7.6	9.75	8.35	6.4	8.55	7.35	.....	.....	7.7
10	8.1	7.9	8.2	7.5	9.35	8.35	6.25	8.05	7.15	.....	.....	7.45
11	7.9	7.9	8.2	7.7	9.25	8.2	6.65	7.6	7.0	.....	.....	7.45
12	8.05	8.15	8.2	7.75	9.15	8.1	6.3	9.0	6.85	.....	.....	7.85
13	8.1	8.0	8.25	8.1	8.75	8.05	6.3	9.3	6.65	.....	.....	8.1
14	7.95	7.9	8.4	8.25	9.0	7.75	6.3	8.65	6.4	.....	7.15	8.1
15	7.9	7.9	8.05	8.55	9.1	7.5	6.2	8.75	6.2	.....	7.2	8.05
16	7.65	7.9	8.05	8.5	9.1	7.45	.....	8.7	6.5	.....	7.2	7.75
17	7.7	7.9	7.9	8.7	9.15	7.45	.....	8.9	6.4	.....	7.2	7.6
18	7.7	8.0	7.7	8.9	9.2	7.4	.....	10.1	6.3	.....	7.25	7.5
19	7.8	8.0	7.55	9.1	9.1	7.45	.....	9.95	6.15	.....	7.3	7.5
20	7.7	8.1	7.45	9.1	8.85	8.5	8.15	9.45	.....	.....	7.3	7.5
21	7.75	7.95	7.3	10.0	8.7	8.45	8.9	9.1	.....	.....	7.3	7.5
22	7.8	7.85	8.35	10.6	9.0	8.6	8.55	8.85	.....	.....	7.3	7.6
23	7.8	7.9	9.0	10.3	9.3	8.4	9.15	8.5	.....	.....	7.3	7.55
24	7.95	7.85	9.0	10.0	9.7	8.3	8.25	8.6	.....	.....	7.3	7.55
25	8.0	8.0	8.8	9.7	10.3	8.1	7.85	8.15	.....	.....	7.3	8.4
26	7.85	8.1	8.65	9.6	10.25	7.9	7.4	8.55	.....	.....	7.3	8.2
27	7.9	7.95	8.6	9.7	10.15	7.75	7.9	9.95	.....	.....	7.25	8.05
28	7.75	7.9	8.4	9.7	10.1	7.6	7.65	9.55	.....	.....	7.2	7.8
29	7.8	8.0	8.3	9.5	9.75	7.35	7.95	8.95	.....	.....	7.35	7.95
30	7.9	.....	8.15	9.5	9.5	7.15	7.9	8.7	.....	.....	7.75	8.55
31	7.85	.....	8.0	.....	9.4	.....	7.75	9.35	.....	.....	.....	8.05

NOTE.—No flow July 4–7, July 16–19, and September 20–November 13, 1908.

Daily discharge, in second-feet, of Rio Grande near El Paso, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	870	690	910	1,870	2,920	9,780	5,190	3,720	4,440	660	1,190	675
2	965	805	860	1,820	3,200	a9,210	5,160	3,580	a 8,620	595	1,130	675
3	a 940	a 875	a 950	a1,740	a 3,980	8,520	a4,980	a3,560	a10,370	a 560	a1,040	a 590
4	1,020	930	995	1,570	4,030	7,600	5,520	3,090	6,660	540	1,260	590
5	900	945	825	1,530	3,950	a7,020	6,330	2,710	a 3,730	520	985	645
6	a 835	a1,000	a 825	a1,440	a 3,720	5,580	6,860	a2,600	3,730	a 530	a 925	a 750
7	750	1,240	665	1,320	3,630	5,640	7,120	3,000	3,200	510	875	695
8	720	1,130	625	1,290	3,690	a5,780	a7,650	2,480	a 2,680	510	820	685
9	a 720	a 920	a 585	a1,370	a 3,650	6,350	7,650	a2,230	2,950	a 470	a 820	a 675
10	675	770	505	1,470	3,510	6,540	7,650	2,220	2,250	420	770	675
11	675	780	500	1,400	3,110	a6,830	6,830	2,200	a 1,830	420	835	675
12	a 905	a 905	a 595	a1,330	a 2,960	6,540	a6,560	a2,080	1,520	a 420	900	a 675
13	1,070	835	560	1,240	2,880	7,320	6,660	1,710	1,330	420	a 835	670
14	1,190	870	635	1,220	2,390	a7,220	6,130	1,380	a 1,330	420	800	585
15	a1,295	a 800	a 825	a1,280	a 2,470	7,070	a6,230	a1,130	1,180	a 455	a 750	a 580
16	1,295	705	860	1,650	2,590	6,770	5,800	970	970	495	825	710
17	1,295	825	890	a3,080	2,720	a6,960	5,470	805	a 880	515	900	675
18	1,970	a 800	a 960	4,210	a 3,090	6,770	a5,130	a 725	1,160	a 520	a 825	a 685
19	a1,400	795	755	a5,070	3,300	6,770	5,000	650	1,020	500	865	615
20	1,240	755	540	5,920	3,350	a8,040	5,070	855	a 1,540	615	1,010	665
21	1,240	a 785	a 540	a6,060	a 3,260	8,280	5,240	a 620	1,650	a 785	a1,110	a 630
22	a1,210	715	470	5,810	3,560	a9,170	a4,920	980	3,640	1,010	1,150	635
23	1,125	645	445	6,460	4,010	9,170	4,680	1,400	a 4,150	880	1,010	520
24	1,045	a 750	a 510	a5,810	4,530	a10,750	4,590	a1,550	4,820	a 850	a1,010	a 565
25	a 960	720	710	4,900	a 5,480	9,440	a4,270	2,590	a 2,630	1,410	885	505
26	880	845	1,860	3,840	6,800	8,260	3,840	2,110	1,760	2,020	965	485
27	760	850	a2,060	a3,750	7,520	a7,590	3,720	a2,280	a 1,360	a1,470	a 945	a 465
28	595	a 820	2,460	3,660	a 7,740	6,890	a3,970	1,740	1,040	2,170	765	435
29	a 630	.....	a2,380	3,410	8,840	6,060	3,770	a3,790	870	1,890	740	435
30	635	.....	1,980	a3,000	a 9,290	a5,230	3,770	5,000	a 780	a1,440	a 760	a 475
31	a 660	.....	a1,980	.....	9,630	.....	a4,350	a4,440	.....	1,190	.....	a 635
1908.												
1	665	395	710	590	1,650	1,770	75	650	1,280	.....	.....	490
2	540	435	830	570	1,380	1,320	45	a 400	745	.....	.....	525
3	515	a 435	a 770	a 650	a 1,340	a1,100	a 30	295	a 355	.....	.....	a 525
4	565	455	670	675	1,340	1,020	.....	460	a 1,760	.....	.....	445
5	640	510	685	555	1,240	1,020	.....	a 460	1,720	.....	.....	370
6	765	a 505	a 785	a 530	a 1,130	a 900	.....	925	535	.....	.....	a 330
7	a 765	555	745	475	1,740	845	.....	a1,290	a 215	.....	.....	260
8	690	520	660	415	2,770	910	85	a1,290	200	.....	.....	315
9	710	a 480	a 575	a 325	2,400	a 845	35	835	125	.....	.....	280
10	a 665	480	615	265	1,920	845	a 5	505	a 75	.....	.....	a 185
11	555	480	705	385	1,800	735	80	a 240	55	.....	.....	185
12	580	a 755	a 795	a 420	1,680	a 665	35	1,160	40	.....	.....	385
13	a 565	675	830	660	1,190	635	35	a1,360	a 20	.....	.....	a 515
14	510	585	920	765	1,500	455	35	830	10	.....	a 50	515
15	490	a 530	a 690	a1,000	1,620	a 305	25	910	5	.....	75	485
16	a 400	515	690	940	1,620	245	.....	a 870	a 20	.....	95	a 290
17	415	500	555	1,190	a 1,670	220	.....	1,020	15	.....	a 115	230
18	415	a 520	a 375	a1,450	1,720	a 155	.....	a1,910	10	.....	150	200
19	a 450	545	290	1,690	1,620	185	.....	1,820	5	.....	180	a 200
20	420	605	275	1,690	1,350	870	510	1,500	.....	.....	180	200
21	450	a 565	a 240	a2,740	a 1,210	840	a1,260	a1,280	.....	.....	a 180	200
22	a 480	540	1,040	3,420	1,560	a 930	885	1,020	.....	.....	170	a 225
23	475	570	a1,560	3,120	1,910	745	1,515	680	.....	.....	160	215
24	530	a 560	1,520	a2,820	a 2,380	650	a 605	a 770	.....	.....	a 155	a 235
25	a 545	615	1,290	2,460	3,230	a 515	485	450	.....	.....	155	745
26	485	650	a1,120	2,310	3,160	440	350	750	.....	.....	155	625
27	505	a 580	1,080	a2,360	3,020	380	a 470	a1,730	.....	.....	145	a 530
28	a 445	560	910	2,230	a 2,960	325	370	1,380	.....	.....	135	365
29	455	a 595	a 825	1,900	2,520	230	455	a 850	.....	.....	a 170	440
30	485	.....	710	a1,800	2,210	a 150	a 440	625	.....	.....	290	785
31	a 455	.....	a 610	.....	a 2,080	.....	395	a1,300	.....	.....	.....	a 495

a Dates of measurement.

NOTE.—No flow July 4–7, July 16–19, and September 20–November 13, 1908.

Monthly discharge of Rio Grande near El Paso, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	1,970	595	983	60,436
February	1,240	645	839	46,621
March	2,460	445	976	60,020
April	6,460	1,220	2,951	175,577
May	9,630	2,390	4,381	269,355
June	10,750	5,230	7,438	442,612
July	7,650	3,720	5,487	337,408
August	5,000	620	2,200	135,263
September	10,370	780	2,801	166,671
October	2,170	420	813	50,003
November	1,260	740	923	54,942
December	750	435	612	37,636
The year	10,750	420	2,534	1,836,544
1908.				
January	765	400	536	32,985
February	755	395	542	31,170
March	1,560	240	777	47,752
April	3,420	265	1,347	80,132
May	3,230	1,130	1,901	116,866
June	1,770	150	675	40,165
July	1,515	0	265	16,314
August	1,910	240	954	58,641
September	1,760	0	240	14,261
October	0	0	0	0
November	290	0	85	5,078
December	785	185	380	23,385
The year	3,420	0	642	466,749

RIO GRANDE ABOVE PRESIDIO, TEX.

The station was established April 4, 1900, by the International Boundary Commission. It was originally located 9 miles above Presidio and 8 miles above the mouth of Rio Conchos, one of the principal tributaries of the Rio Grande, and about 200 miles below El Paso. The station was in a straight stretch of the river, but in the bight of a long bend. In 1905 the river began to erode a cut-off across this bend, and the spring flood of 1905 deepened this channel to such an extent that more water passed through it than through the station, and it became necessary to abandon the location. In September, 1905, the station was moved 8 miles farther upstream and rebuilt. Its location is far enough above the mouth of Rio Conchos to be free from the effects of backwater from that stream.

The river is nearly straight for one-fourth mile above and below the new location. Both banks overflow slightly in extreme flood, but no large amount of water passes outside the measured section. The bed is shifting sand. The banks are fairly solid, but would erode if a heavy current should strike them. Frequent discharge measurements are necessary to determine closely the daily discharge.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande above Presidio, Tex., in 1907.

[By F. X. Dougherty.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 1	231	4.3	559	July 4	1,200	7.4	5,174
January 4	256	4.5	639	July 7	1,103	7.2	4,423
January 7	266	4.5	669	July 10	1,179	7.3	4,731
January 10	297	4.6	819	July 13	1,333	7.7	6,368
January 13	250	4.4	643	July 16	1,124	7.4	4,944
January 16	244	4.3	592	July 19	1,006	7.25	4,860
January 19	295	4.8	913	July 22	712	6.3	3,399
January 22	390	5.3	1,384	July 25	705	6.3	3,348
January 25	335	5.0	1,150	July 28	665	6.05	3,086
January 28	299	4.8	855	July 31	702	6.15	3,269
January 31	256	4.5	682	August 3	585	5.7	2,682
February 3	232	4.3	661	August 6	529	5.4	2,393
February 6	242	4.3	653	August 9	528	5.3	2,103
February 9	261	4.3	718	August 12	428	5.1	1,525
February 12	293	4.7	1,030	August 15	358	5.0	1,348
February 15	259	4.4	786	August 18	262	4.7	876
February 18	290	4.7	966	August 21	257	4.7	842
February 21	253	4.3	694	August 24	232	4.4	682
February 24	258	4.3	695	August 27	257	4.8	1,018
February 27	249	4.3	666	August 30	248	4.7	904
March 3	220	4.25	591	September 2	1,074	7.3	5,361
March 5	226	4.3	648	September 5	965	6.9	3,758
March 8	252	4.6	829	September 8	1,445	7.7	6,826
March 11	229	4.3	649	September 11	704	6.2	2,540
March 14	219	4.2	565	September 14	512	5.5	1,689
March 17	179	4.1	452	September 17	405	5.0	1,477
March 20	204	4.2	554	September 20	471	5.35	1,621
March 23	204	4.2	556	September 23	519	5.4	1,734
March 27	174	4.0	359	September 26	738	6.4	3,341
March 30	200	4.2	547	September 29	543	5.8	2,312
April 2	376	5.45	1,586	October 2	330	5.0	1,135
April 5	336	5.3	1,369	October 5	292	4.8	992
April 8	293	5.0	1,076	October 8	251	4.3	610
April 11	273	4.7	894	October 11	246	4.3	586
April 14	271	4.7	889	October 14	215	4.1	451
April 17	268	4.6	816	October 17	221	4.25	501
April 20	314	5.0	1,181	October 20	400	5.5	1,856
April 23	653	6.3	2,815	October 23	312	4.9	1,132
April 26	797	6.9	4,073	October 26	295	4.8	1,070
April 29	857	7.1	4,353	October 30	508	5.9	2,459
May 2	607	6.2	2,740	November 2	453	5.4	1,613
May 5	572	6.0	2,499	November 4	347	5.0	1,170
May 8	630	6.3	2,787	November 7	327	4.8	1,053
May 11	549	6.0	2,430	November 10	309	4.7	965
May 14	596	6.1	2,644	November 13	288	4.6	819
May 17	496	5.7	1,981	November 16	320	4.6	866
May 20	512	5.9	2,117	November 19	293	4.5	728
May 23	571	6.1	2,656	November 22	261	4.4	689
May 26	587	6.1	2,720	November 25	296	4.7	976
May 29	686	6.4	3,257	November 29	314	4.6	849
June 1	889	7.1	4,535	December 2	246	4.5	722
June 4	1,078	7.6	5,667	December 5	238	4.5	722
June 7	1,596	8.0	8,261	December 8	215	4.4	652
June 10	1,115	7.5	5,552	December 11	228	4.5	719
June 13	1,057	7.5	5,421	December 14	204	4.2	540
June 16	1,104	7.65	5,993	December 17	196	4.2	540
June 19	1,191	7.85	6,789	December 20	188	4.1	445
June 22	1,193	7.8	6,719	December 23	203	4.2	519
June 25	1,600	8.0	8,222	December 26	189	4.1	481
June 28	1,717	8.2	9,124	December 30	181	4.1	457
July 1	1,621	8.0	8,374				

Discharge measurements of Rio Grande above Presidio, Tex., in 1908.

[By F. X. Dougherty and W. T. Millington.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	186	4.05	415	June 3	468	5.15	1,739
January 5	188	4.1	444	June 6	357	4.55	1,303
January 8	187	4.1	422	June 9	292	4.2	931
January 11	231	4.4	647	June 12	263	4.0	593
January 14	216	4.2	529	June 15	193	3.9	340
January 17	226	4.35	604	June 18	165	3.8	282
January 20	206	4.2	500	June 21	127	3.55	160
January 23	168	4.1	469	June 24	95	3.2	67
January 27	156	4.1	466	June 27	74	2.9	52
January 30	177	4.2	496	June 30	54	3.0	30
February 4	171	4.0	404	July 4	212	4.0	249
February 7	165	4.0	402	July 7	122	3.0	103
February 10	166	4.0	401	July 10	37	2.85	8
February 13	206	4.2	521	July 13	24	2.8	5
February 16	181	4.15	480	July 22	213	4.0	243
February 19	199	4.2	535	July 26	365	4.6	642
February 22	196	4.2	504	July 28	387	4.6	393
February 25	165	4.0	393	July 31	252	4.0	186
February 28	187	4.0	397	August 3	127	3.6	99
March 2	159	3.9	344	August 6	319	4.6	844
March 5	160	3.9	349	August 9	165	4.0	362
March 8	210	4.2	489	August 12	259	4.4	615
March 11	195	4.1	477	August 15	189	4.1	379
March 14	183	4.1	456	August 18	254	4.4	623
March 17	172	4.1	436	August 21	247	4.4	602
March 20	179	4.2	466	August 24	265	4.7	730
April 9	200	4.1	393	August 27	228	4.3	544
April 13	130	4.1	345	August 30	231	4.4	556
April 15	112	3.9	242	September 1	499	5.1	1,781
April 18	110	3.9	235	September 4	400	4.7	1,162
April 21	223	4.3	596	September 7	247	4.05	571
April 24	292	4.7	853	September 11	227	3.95	511
April 27	585	5.7	2,515	September 14	137	3.6	224
April 29	467	5.3	1,964	September 16	176	3.4	175
May 3	429	5.0	1,538	September 19	55	3.1	74
May 7	381	4.5	1,472	September 22	52	3.0	68
May 11	471	4.9	1,665	September 25	37	2.7	43
May 13	462	5.15	1,525	December 13	39	3.2	33
May 16	407	4.6	1,386	December 16	43	3.2	38
May 19	418	4.8	1,454	December 19	51	3.05	23
May 22	351	4.85	1,098	December 23	96	3.5	92
May 25	337	4.4	1,129	December 26	61	3.3	75
May 28	482	5.4	1,960	December 30	62	3.3	80
May 31	670	5.95	2,486				

NOTE.—No measurements were made in October and November, 1908, as there was no flow.

Daily gage height, in feet, of Rio Grande above Presidio, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.3	4.45	4.25	5.25	6.55	7.0	8.05	5.8	6.9	5.1	5.5	4.6
2	4.45	4.35	4.3	5.35	6.25	7.35	8.2	5.55	7.2	4.95	5.5	4.55
3	4.45	4.3	4.3	5.3	6.1	7.55	7.75	5.8	6.8	4.85	5.1	4.5
4	4.45	4.3	4.3	5.25	6.0	7.65	7.4	5.65	6.85	4.8	4.95	4.45
5	4.45	4.3	4.35	5.3	5.95	7.8	7.3	5.45	7.05	4.75	4.95	4.45
6	4.45	4.3	4.45	5.15	6.15	7.9	7.2	5.35	7.15	4.55	4.85	4.35
7	4.5	4.3	4.45	5.0	6.3	8.0	7.25	5.3	7.4	4.45	4.75	4.4
8	4.6	4.3	4.6	5.0	6.3	8.0	7.35	5.3	7.7	4.35	4.8	4.4
9	4.65	4.3	4.45	4.9	6.2	7.75	7.35	5.3	6.9	4.35	4.8	4.35
10	4.6	4.5	4.4	4.8	6.15	7.5	7.4	5.6	6.55	4.25	4.7	4.35
11	4.6	4.75	4.35	4.7	6.05	7.4	7.45	5.45	6.25	4.3	4.7	4.45
12	4.5	4.65	4.25	4.65	6.1	7.45	7.4	5.15	6.15	4.3	4.7	4.25
13	4.45	4.6	4.2	4.65	6.1	7.5	7.7	5.05	5.85	4.25	4.55	4.25
14	4.4	4.5	4.15	4.7	6.0	7.55	7.5	5.05	5.55	4.15	4.45	4.2
15	4.35	4.45	4.1	4.7	5.8	7.55	7.45	4.95	5.25	4.35	4.45	4.25
16	4.35	4.4	4.15	4.65	5.85	7.65	7.5	4.8	5.1	4.35	4.5	4.3
17	4.65	4.5	4.1	4.6	5.7	7.9	7.25	4.75	5.0	4.25	4.55	4.25
18	4.7	4.65	4.1	4.55	5.6	7.85	6.95	4.7	4.95	4.2	4.45	4.1
19	4.8	4.6	4.1	4.6	5.6	7.9	7.25	4.6	4.8	4.25	4.5	4.1
20	4.9	4.5	4.2	4.95	5.85	7.9	6.55	4.65	5.3	5.4	4.45	4.1
21	5.05	4.4	4.3	5.6	5.9	7.95	6.45	4.6	5.45	5.1	4.6	4.05
22	5.35	4.3	4.3	6.0	6.0	7.8	6.3	4.5	5.25	5.05	4.45	4.2
23	5.2	4.3	4.2	6.35	6.05	7.85	6.4	4.4	5.35	4.8	4.4	4.2
24	5.1	4.35	4.15	6.55	6.0	7.95	6.4	4.4	5.2	4.7	4.5	4.15
25	5.0	4.3	4.1	6.75	5.9	8.0	6.3	4.35	6.0	4.65	4.65	4.1
26	5.0	4.3	4.0	6.95	6.1	8.0	6.25	4.3	6.45	4.75	4.7	4.1
27	4.9	4.3	3.95	7.05	6.15	8.05	6.15	4.75	6.7	4.85	4.95	4.2
28	4.8	4.25	4.0	7.2	6.4	8.15	6.0	5.0	6.2	4.65	4.75	4.2
29	4.7	.....	4.0	7.05	6.45	8.1	5.8	5.35	5.7	5.6	4.65	4.2
30	4.7	.....	4.2	6.95	6.6	8.05	6.0	4.8	5.45	5.9	4.6	4.15
31	4.55	.....	4.85	.....	6.8	.....	6.1	7.75	.....	5.46	.....	4.1
1908.												
1	4.1	4.0	4.05	4.45	5.3	5.7	3.75	3.9	4.95	.....	.....	.....
2	4.0	3.95	3.9	4.35	5.3	5.35	3.5	3.65	4.65	.....	.....	.....
3	4.0	4.0	4.0	4.3	5.0	5.15	4.4	3.6	5.05	.....	.....	.....
4	4.0	4.05	4.0	4.25	4.9	4.9	4.0	5.3	4.7	.....	.....	.....
5	4.05	4.0	3.95	4.2	4.7	4.75	3.45	6.15	4.55	.....	.....	.....
6	4.25	4.05	4.25	4.2	4.7	4.55	3.1	4.45	4.3	.....	.....	.....
7	4.15	4.05	4.35	4.1	4.5	4.35	3.0	5.1	4.05	.....	.....	.....
8	4.15	4.05	4.15	4.1	4.5	4.25	3.0	4.5	4.4	.....	.....	.....
9	4.2	4.0	4.1	4.1	4.5	4.2	2.9	3.9	4.3	.....	.....	.....
10	4.2	4.05	4.05	4.1	4.4	4.15	2.85	3.65	4.15	.....	.....	.....
11	4.4	4.0	4.1	4.1	4.95	4.05	2.9	3.65	3.95	.....	.....	3.0
12	4.45	4.05	4.05	4.15	5.3	4.0	2.9	4.45	3.85	.....	.....	3.1
13	4.35	4.2	4.1	4.1	5.15	4.0	2.75	4.35	3.75	.....	.....	3.2
14	4.2	4.2	4.15	4.05	4.9	3.9	.....	4.25	3.6	.....	.....	3.2
15	4.35	4.15	4.1	3.85	4.75	3.9	.....	4.05	3.45	.....	.....	3.1
16	4.35	4.15	4.1	3.8	4.6	3.9	.....	3.85	3.4	.....	.....	3.2
17	4.35	4.15	4.1	3.95	4.65	3.85	.....	4.55	3.3	.....	.....	3.2
18	4.3	4.2	4.1	3.9	4.75	3.8	.....	4.35	3.2	.....	.....	3.1
19	4.2	4.2	4.2	4.15	4.8	3.8	3.0	4.35	3.1	.....	.....	3.0
20	4.2	4.2	4.2	4.3	4.8	3.65	.....	4.6	3.0	.....	.....	3.5
21	4.15	4.2	4.2	4.3	4.8	3.55	3.65	4.45	2.95	.....	.....	3.6
22	4.0	4.15	4.1	4.65	4.85	3.45	4.35	5.0	2.95	.....	.....	3.55
23	4.1	4.1	4.05	4.7	4.7	3.35	4.2	4.95	2.8	.....	.....	3.5
24	4.1	4.15	3.95	4.7	4.5	3.2	4.2	4.9	2.75	.....	.....	3.4
25	4.1	4.05	3.85	5.6	4.4	3.2	4.0	4.75	2.7	.....	.....	3.3
26	4.05	4.15	3.75	5.7	4.75	2.95	4.75	4.5	2.55	.....	.....	3.3
27	4.05	4.1	3.75	5.65	4.95	2.9	4.35	4.2	.....	.....	.....	3.3
28	4.1	4.05	4.75	5.45	5.4	2.9	4.55	4.25	.....	.....	.....	3.3
29	4.1	4.05	4.7	5.3	5.8	3.0	4.7	4.8	.....	.....	.....	3.3
30	4.15	.....	4.6	5.35	5.8	3.0	4.2	4.4	.....	.....	.....	3.3
31	4.15	.....	4.5	.....	5.95	.....	3.95	4.3	.....	.....	.....	3.3

NOTE.—No flow July 14–18, July 20, and September 27–December 10, 1908.

Daily discharge, in second-feet, of Rio Grande above Presidio, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	a560	680	620	1,460	3,350	a4,380	a8,640	2,810	4,270	1,260	1,860	825
2	620	670	635	a1,520	a2,830	5,100	9,440	2,490	a5,090	a1,100	a1,730	a765
3	620	a660	a620	1,410	2,620	5,550	7,040	a2,780	3,360	1,030	1,280	720
4	a620	660	635	1,340	2,500	a5,990	a5,170	2,630	3,560	990	a1,140	685
5	630	655	a680	a1,370	a2,450	6,970	4,800	2,440	a4,330	a950	1,140	a685
6	640	a655	740	1,220	2,640	7,620	4,420	a2,340	4,710	800	1,080	615
7	a670	675	740	1,080	2,790	a8,260	a4,580	2,200	5,670	730	a1,010	650
8	760	695	a830	a1,080	a2,790	8,260	4,880	2,150	a6,830	a650	1,050	a650
9	820	a720	740	1,010	2,670	6,910	4,880	a2,100	4,540	630	1,050	620
10	a820	875	710	950	2,610	a5,550	a5,140	2,400	3,540	565	a965	620
11	800	1,070	a680	a890	a2,490	5,210	5,340	2,140	a2,680	a585	940	a685
12	720	a990	605	855	2,590	5,310	5,140	a1,610	2,480	585	915	570
13	a670	950	565	855	2,620	a5,420	a6,370	1,440	2,120	550	a790	570
14	645	865	a510	a890	a2,480	5,610	5,420	1,440	a1,750	a485	745	a540
15	620	a825	450	890	2,150	5,610	5,180	a1,270	1,580	600	760	570
16	a620	785	510	855	2,230	a5,990	a5,420	1,040	1,520	600	a805	600
17	815	855	a450	a815	a1,980	6,990	4,640	960	a1,480	a500	805	a570
18	850	a960	450	780	1,830	6,790	4,040	a880	1,460	445	710	445
19	a915	920	450	815	1,790	a6,990	a4,860	760	1,400	500	a730	445
20	1,005	845	a555	a1,130	a2,060	6,990	3,780	800	a1,600	a1,740	705	a445
21	1,150	a770	655	1,940	2,200	7,190	3,630	a740	1,770	1,370	835	410
22	a1,420	695	655	2,440	2,430	a6,720	a3,400	740	1,510	1,310	a730	520
23	1,310	695	a555	a2,920	2,590	7,150	3,530	680	a1,660	a1,070	690	a520
24	1,230	a730	505	3,340	2,540	7,790	3,510	a680	1,410	1,010	785	500
25	a1,150	685	460	3,760	2,420	a8,220	a3,350	640	2,700	975	a930	480
26	1,100	675	360	a4,170	a2,720	8,220	3,300	600	a3,430	a1,040	975	a480
27	980	a665	a310	4,370	2,810	8,440	3,190	a980	3,850	1,130	1,230	535
28	a855	635	360	4,670	3,260	a8,900	a2,990	1,250	3,000	880	1,010	530
29	795	.....	360	a4,250	a3,360	8,750	2,630	1,640	a2,140	2,080	a905	520
30	740	.....	a545	4,050	3,660	8,560	2,990	a1,020	1,720	a2,460	850	a485
31	a710	.....	1,200	.....	4,060	.....	a3,180	6,570	.....	1,920	.....	455
1908.												
1	455	405	425	735	1,890	2,250	195	165	a1,550	.....	.....	.....
2	a385	380	a345	660	1,800	1,930	140	110	1,080	.....	.....	.....
3	385	405	385	610	a1,360	a1,740	530	a100	1,700	.....	.....	.....
4	385	a430	390	565	1,400	1,560	a250	1,490	a1,160	.....	.....	.....
5	a415	405	a370	520	1,380	1,450	165	2,510	1,030	.....	.....	.....
6	525	435	515	505	1,490	a1,300	120	a725	800	.....	.....	.....
7	460	a430	560	430	a1,470	1,090	a105	1,290	a570	.....	.....	.....
8	a450	430	a485	410	1,470	985	85	765	885	.....	.....	.....
9	495	400	475	a395	1,470	a930	40	a300	800	.....	.....	.....
10	510	a430	470	380	1,430	830	a10	140	675	.....	.....	.....
11	a645	400	a475	370	a1,670	695	20	140	a510	.....	.....	25
12	675	430	460	385	1,820	a595	20	a650	430	.....	.....	30
13	620	a520	465	a345	a1,530	530	a5	575	345	.....	.....	a35
14	a530	515	a465	320	1,470	405	.....	495	a225	.....	.....	35
15	605	485	450	a240	1,430	a340	.....	a340	185	.....	.....	30
16	605	a480	440	200	a1,390	340	.....	175	a175	.....	.....	a40
17	a605	490	a435	260	1,400	310	.....	740	140	.....	.....	40
18	570	525	435	a235	1,440	a280	.....	a585	105	.....	.....	30
19	500	a535	465	425	a1,450	280	40	575	a75	.....	.....	a20
20	a500	525	a465	555	1,330	210	.....	770	70	.....	.....	90
21	480	515	465	a595	1,200	a160	175	a640	65	.....	.....	105
22	410	a475	420	820	a1,100	135	a480	1,140	a65	.....	.....	100
23	a470	450	395	850	1,110	105	380	1,070	50	.....	.....	a90
24	470	475	350	a855	1,100	a65	380	a1,000	45	.....	.....	80
25	465	a420	305	2,350	a1,130	65	245	755	a45	.....	.....	75
26	445	475	260	2,510	1,420	55	a745	640	15	.....	.....	a75
27	a450	450	260	a2,450	1,590	a50	445	a500	.....	.....	.....	75
28	465	a425	1,010	2,170	1,960	40	a375	525	.....	.....	.....	75
29	465	425	965	a1,960	2,340	40	425	945	.....	.....	.....	80
30	a480	.....	870	2,030	2,340	30	250	a555	.....	.....	.....	a80
31	480	.....	780	.....	2,490	.....	a175	510	.....	.....	.....	80

a Dates of measurement.

NOTE.—No flow July 14–18, July 20, and September 27–December 11, 1908.

Monthly discharge of Rio Grande above Presidio, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet.)
	Maximum.	Minimum.	Mean.	
1907.				
January	1,420	560	834	51,293
February	1,070	635	770	42,764
March	1,200	310	585	35,980
April	4,670	780	1,904	113,306
May	4,060	1,790	2,630	161,693
June	8,900	4,380	6,848	407,484
July	9,440	2,630	4,674	287,365
August	6,570	600	1,685	103,577
September	6,830	1,400	2,905	172,879
October	2,460	445	985	60,575
November	1,860	690	972	57,818
December	825	410	571	35,127
The year	9,440	310	2,114	1,529,861
1908.				
January	675	385	497	30,545
February	535	380	454	26,112
March	1,010	260	486	29,861
April	2,510	200	838	49,855
May	2,490	1,100	1,544	94,949
June	2,250	30	626	37,279
July	745	0	187	11,504
August	2,510	100	675	41,494
September	1,700	0	426	25,379
October	0	0	0	0
November	0	0	0	0
December	105	0	42	2,559
The year	2,510	0	481	349,537

RIO GRANDE BELOW PRESIDIO, TEX.

The station was established April 8, 1900, by the International Boundary Commission. It is 6 miles below Presidio, 7 miles below the mouth of Rio Conchos, and about 215 miles below El Paso. It is at the west end of the canyon section of the Rio Grande. The discharge at this station minus the discharge at the station above Presidio, Tex., is the discharge of Rio Conchos, except at rare intervals, when some rain water enters the Rio Grande from the north.

The river is fairly straight at the station and for one-fourth mile above and below. The right bank is a rocky bluff. The left bank is an alluvial deposit and overflows for 750 feet back from the river, where gravel hills are found. The bed is shifting sand and is affected by a drainage line called Alamos Creek, which reaches the river one-fourth mile below the station. This is subject to torrential floods, which bring large quantities of bowlders and gravel into the Rio Grande, forming a temporary dam, which remains, throwing backwater onto the gage, until a flood in the river scours it out. The extreme floods come from Rio Conchos, the highest recorded gage height being 26.35 feet on September 11, 1904. Frequent discharge measurements are made to determine closely the daily flow.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande below Presidio, Tex., in 1907.

[By F. X. Dougherty.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	813	7.5	1,152	July 6	987	9.3	5,726
January 5	798	7.5	1,097	July 9	935	9.2	5,210
January 8	787	7.5	1,066	July 11	1,036	9.4	6,200
January 11	839	7.6	1,359	July 14	1,016	9.4	6,085
January 15	746	7.4	1,004	July 17	956	9.3	5,762
January 17	764	7.5	1,129	July 20	774	9.1	4,283
January 20	799	7.5	1,293	July 24	824	9.1	4,444
January 23	831	7.75	1,587	July 26	832	9.1	4,382
January 26	939	8.1	2,336	July 29	951	9.25	5,399
January 29	910	7.8	1,900	August 1	996	9.3	5,685
February 1	808	7.7	1,368	August 4	953	9.25	5,284
February 4	758	7.6	1,218	August 8	781	8.75	3,598
February 7	752	7.6	1,185	August 10	869	9.05	4,475
February 10	718	7.5	1,086	August 13	765	8.75	3,623
February 13	719	7.6	1,197	August 17	605	8.3	1,676
February 16	706	7.6	1,161	August 19	729	8.5	2,158
February 19	695	7.6	1,109	August 22	681	8.35	1,920
February 22	695	7.5	1,082	August 25	1,028	9.45	6,049
February 25	637	7.4	971	August 28	977	9.3	5,434
February 28	636	7.4	969	August 31	1,397	10.45	8,597
March 4	552	7.4	900	September 3	1,869	11.5	11,706
March 6	534	7.4	837	September 6	1,765	11.3	10,953
March 9	582	7.5	1,007	September 9	2,045	11.7	13,285
March 12	539	7.4	900	September 12	1,842	11.2	10,485
March 16	533	7.4	890	September 15	1,384	10.1	7,662
March 18	480	7.2	586	September 18	2,242	11.95	14,157
March 21	501	7.3	660	September 21	2,075	11.75	12,380
March 24	485	7.3	663	September 24	1,634	10.4	9,517
March 28	441	7.0	441	September 27	1,463	10.2	8,400
March 31	544	7.5	881	September 30	1,109	9.2	5,506
April 3	784	7.9	1,559	October 3	1,064	8.4	2,656
April 6	711	7.9	1,451	October 6	910	8.1	2,329
April 9	594	7.7	1,130	October 9	799	7.9	1,694
April 12	558	7.6	998	October 12	803	7.8	1,310
April 15	513	7.5	916	October 16	859	8.0	1,787
April 18	483	7.4	822	October 18	779	7.8	1,366
April 22	618	8.1	1,934	October 21	1,099	9.3	5,700
April 24	831	8.6	3,640	October 24	847	8.4	2,461
April 27	1,004	8.8	4,079	October 27	808	8.3	2,191
April 30	1,072	8.7	4,402	October 31	860	8.5	2,666
May 3	796	8.6	3,590	November 3	886	8.35	2,391
May 6	731	8.5	2,813	November 5	1,043	9.35	5,760
May 9	749	8.5	3,074	November 8	2,188	11.85	13,849
May 12	696	8.4	2,598	November 11	1,265	9.45	6,429
May 15	687	8.3	2,321	November 14	1,165	8.6	3,818
May 19	637	8.2	1,945	November 17	1,161	8.5	2,965
May 21	619	8.2	1,987	November 20	1,099	8.2	2,516
May 24	642	8.3	2,352	November 23	1,083	8.1	2,187
May 27	771	8.6	3,280	November 27	1,198	8.2	2,656
May 31	828	8.9	4,077	November 30	2,467	12.2	14,848
June 2	949	9.1	4,936	December 3	1,723	10.3	8,840
June 5	999	9.2	5,271	December 6	1,442	9.65	6,875
June 8	1,189	9.7	7,134	December 9	1,309	9.5	5,523
June 11	1,156	9.4	6,209	December 12	1,244	8.9	4,640
June 14	1,071	9.3	5,662	December 15	1,178	8.6	3,300
June 17	1,155	9.5	6,421	December 18	1,170	8.4	2,739
June 20	1,336	10.3	8,229	December 21	987	8.2	2,202
June 23	1,232	10.0	7,281	December 24	1,009	8.1	2,052
June 26	1,208	9.7	6,756	December 27	952	8.0	1,883
June 29	1,286	10.1	7,690	December 31	896	7.8	1,527
July 2	1,252	10.05	7,502				

Discharge measurements of Rio Grande below Presidio, Tex., in 1908.

[By F. X. Dougherty and W. T. Millington.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	829	7.7	1,343	July 9	161	6.1	126
January 7	861	7.7	1,433	July 12	135	6.1	89
January 9	762	7.6	1,185	July 15	123	5.95	78
January 12	795	7.7	1,306	July 17	309	7.1	184
January 15	782	7.65	1,239	July 18	131	6.15	35
January 19	760	7.5	1,085	July 21	275	7.2	207
January 22	747	7.4	998	July 23	2,489	13.1	12,791
January 24	745	7.4	979	July 24	1,206	9.6	2,138
January 28	682	7.3	903	July 27	1,785	11.2	5,989
January 31	661	7.3	861	July 30	1,094	9.5	2,928
February 3	663	7.2	798	August 4	1,803	11.3	5,140
February 6	656	7.2	765	August 7	1,713	10.9	3,910
February 9	661	7.2	773	August 14	2,006	11.5	4,826
February 12	658	7.2	761	August 16	1,542	10.1	3,045
February 14	678	7.5	1,060	August 19	1,341	9.7	2,436
February 17	666	7.4	950	August 22	1,413	9.9	3,408
February 20	695	7.5	1,026	August 25	1,450	10.1	3,182
February 23	655	7.3	880	August 28	1,350	10.2	2,597
February 27	659	7.3	870	August 31	2,517	12.8	10,676
February 29	647	7.2	817	September 2	3,547	15.15	18,655
March 3	592	7.05	654	September 5	3,725	15.35	20,553
March 7	610	7.2	823	September 8	1,662	10.05	4,942
March 9	572	7.0	620	September 10	2,163	11.7	9,192
March 12	572	7.0	614	September 13	1,820	10.6	6,453
March 15	586	7.0	621	September 17	1,349	8.8	3,894
March 18	554	6.9	567	September 20	1,257	8.5	3,435
March 21	580	7.0	593	September 23	1,164	8.1	1,522
March 25	553	6.9	535	September 26	1,017	7.8	1,175
March 28	535	6.9	572	September 30	808	7.5	917
March 31	587	7.2	788	October 3	739	7.4	730
April 3	586	7.0	608	October 6	715	7.3	633
April 6	514	6.8	508	October 9	694	7.1	629
April 10	583	6.8	450	October 12	674	7.0	554
April 14	728	7.5	646	October 15	645	6.9	501
April 16	652	7.1	420	October 19	623	6.9	601
April 19	631	7.0	394	October 22	617	6.8	419
April 22	708	7.4	592	October 25	581	6.8	454
April 26	1,030	8.7	2,548	October 28	557	6.8	458
April 30	927	8.4	1,727	October 31	575	6.8	405
May 4	817	8.15	1,589	November 2	595	6.8	458
May 8	699	7.7	1,274	November 5	612	6.8	395
May 12	857	8.3	1,635	November 8	622	6.8	383
May 14 [a]	775	8.15	1,147	November 11	614	6.8	381
May 17	722	7.7	1,103	November 15	615	6.8	389
May 20	707	7.9	1,092	November 18	628	6.8	418
May 23	660	7.85	1,038	November 21	625	6.8	423
May 26	744	7.65	1,187	November 24	614	6.8	497
May 30	1,022	8.75	2,407	November 27	612	6.7	454
June 2	820	8.45	1,629	November 30	567	6.7	374
June 5	666	8.05	1,132	December 3	564	6.7	387
June 8	539	7.55	933	December 6	558	6.7	402
June 11	511	7.5	882	December 9	566	6.7	407
June 14	479	7.15	806	December 12	565	6.7	430
June 17	453	7.1	352	December 15	586	6.9	494
June 20	301	6.85	285	December 18	621	6.8	614
June 23	284	6.55	270	December 21	607	6.75	628
June 26	241	6.3	165	December 24	618	6.85	650
June 29	191	6.1	43	December 27	615	6.75	705
July 3	845	8.15	1,822	December 31	611	6.75	625
July 6	251	6.35	221				

[a] Measurement too small; rejected.

Daily gage height, in feet, of Rio Grande below Presidio, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	7.5	7.75	7.4	7.9	8.55	8.95	10.05	9.25	10.75	8.7	8.35	13.25
2	7.5	7.7	7.4	7.95	8.55	9.1	10.1	9.2	10.95	8.5	8.6	12.15
3	7.5	7.7	7.4	7.9	8.55	9.05	10.25	9.25	11.5	8.35	8.45	10.6
4	7.55	7.65	7.4	7.95	8.35	9.05	10.4	9.3	11.55	8.2	8.45	9.8
5	7.5	7.6	7.4	7.95	8.3	9.3	9.4	9.2	11.65	8.1	9.55	9.65
6	7.5	7.6	7.45	7.9	8.4	9.4	9.35	9.1	11.4	8.15	13.4	9.6
7	7.5	7.6	7.45	7.8	8.55	9.5	9.35	9.0	11.35	8.1	13.9	9.5
8	7.5	7.6	7.6	7.75	8.55	9.7	9.4	8.8	12.4	8.05	11.55	9.5
9	7.6	7.55	7.55	7.65	8.45	9.75	9.25	8.9	11.85	7.95	9.9	9.5
10	7.6	7.5	7.5	7.6	8.4	9.5	9.3	9.0	11.05	7.9	9.45	9.15
11	7.6	7.75	7.45	7.55	8.4	9.35	9.4	8.95	11.05	7.8	9.35	9.1
12	7.55	7.75	7.4	7.5	8.4	9.2	9.45	8.95	11.2	7.8	8.95	8.85
13	7.5	7.65	7.4	7.4	8.35	9.2	9.4	8.65	10.35	7.75	8.8	8.8
14	7.5	7.6	7.4	7.5	8.4	9.25	9.4	8.65	10.2	7.65	8.7	8.7
15	7.4	7.6	7.4	7.5	8.35	9.3	9.6	8.55	10.1	7.6	8.6	8.6
16	7.5	7.55	7.35	7.5	8.25	9.45	9.7	8.35	10.35	8.05	8.4	8.55
17	7.55	7.6	7.25	7.5	8.3	9.6	9.55	8.3	10.6	7.85	8.45	8.5
18	7.7	7.6	7.2	7.45	8.3	10.05	9.3	8.3	12.0	7.75	8.35	8.4
19	7.7	7.6	7.2	7.4	8.2	10.15	9.25	8.4	11.75	7.6	8.3	8.35
20	7.55	7.6	7.25	7.45	8.2	10.2	9.1	8.25	11.3	8.0	8.2	8.25
21	7.6	7.5	7.3	7.85	8.25	10.1	9.05	8.3	11.8	9.25	8.2	8.15
22	7.85	7.5	7.3	8.15	8.3	10.05	9.0	8.3	10.95	8.85	8.2	8.15
23	7.75	7.5	7.3	8.4	8.4	10.05	9.05	8.2	10.55	8.7	8.15	8.1
24	7.7	7.5	7.3	8.55	8.35	9.9	9.05	10.5	10.4	8.5	8.1	8.1
25	7.75	7.45	7.2	8.7	8.35	9.8	9.05	9.65	10.15	8.3	8.1	8.05
26	8.05	7.4	7.1	8.8	8.4	9.8	9.05	9.4	10.05	8.25	8.0	8.0
27	8.15	7.4	7.05	8.8	8.55	9.9	9.0	9.25	10.15	8.3	8.1	8.0
28	8.1	7.4	7.0	8.9	8.65	9.9	9.25	9.25	9.55	8.4	8.35	7.95
29	7.85	.....	7.0	8.85	8.75	9.9	9.2	9.3	9.25	8.55	8.4	7.9
30	7.9	.....	7.05	8.7	8.8	10.1	9.45	9.5	9.0	8.95	12.45	7.8
31	7.9	.....	7.7	.....	8.95	.....	9.3	10.45	.....	8.55	.....	7.8
1908.												
1	7.7	7.2	7.1	7.25	8.55	8.85	6.9	9.65	15.8	7.4	6.8	6.7
2	7.7	7.2	7.1	7.1	8.4	8.45	6.55	9.9	15.15	7.4	6.8	6.7
3	7.7	7.2	7.05	7.0	8.3	8.3	8.15	11.3	15.15	7.35	6.8	6.7
4	7.7	7.2	7.1	7.0	8.15	8.2	7.3	11.35	15.45	7.3	6.8	6.7
5	7.7	7.2	7.05	6.9	8.0	8.05	6.8	11.25	15.35	7.3	6.8	6.7
6	7.7	7.2	7.1	6.85	7.9	7.85	6.35	10.85	13.15	7.25	6.8	6.7
7	7.7	7.15	7.15	6.8	7.75	7.75	6.25	10.9	10.7	7.2	6.8	6.7
8	7.65	7.15	7.15	6.8	7.7	7.55	6.1	11.15	10.05	7.1	6.8	6.7
9	7.6	7.2	7.0	6.8	7.7	7.5	6.1	11.6	10.75	7.1	6.8	6.7
10	7.6	7.2	7.0	6.8	7.6	7.55	6.1	13.9	11.7	7.1	6.8	6.7
11	7.6	7.2	7.05	6.9	7.7	7.5	6.1	17.6	11.55	7.0	6.8	6.7
12	7.65	7.2	7.05	7.55	8.3	7.3	6.1	16.4	10.85	7.0	6.8	6.7
13	7.7	7.2	7.0	7.4	8.3	7.25	6.1	14.05	10.6	7.0	6.8	6.7
14	7.65	7.4	7.05	7.4	8.15	7.15	6.05	11.25	10.3	7.0	6.8	6.75
15	7.6	7.4	7.05	7.25	7.95	7.1	5.95	10.15	9.6	6.9	6.8	6.9
16	7.65	7.4	7.0	7.1	7.75	7.1	5.95	10.05	9.25	6.9	6.8	6.8
17	7.65	7.4	7.0	7.1	7.7	7.1	7.1	9.95	8.8	6.9	6.8	6.8
18	7.55	7.5	6.95	7.05	7.65	7.05	6.15	9.8	8.7	6.9	6.8	6.8
19	7.5	7.5	6.9	7.0	7.9	7.0	6.1	9.7	8.6	6.9	6.8	6.75
20	7.5	7.5	6.95	7.35	7.9	6.85	6.4	9.7	8.45	6.9	6.8	6.7
21	7.5	7.4	6.95	7.4	7.9	6.8	7.25	9.7	8.3	6.85	6.8	6.8
22	7.4	7.3	7.0	7.45	8.0	6.75	7.25	9.9	8.15	6.8	6.8	6.8
23	7.4	7.3	7.05	7.7	7.85	6.55	11.85	9.9	8.1	6.8	6.8	6.85
24	7.4	7.3	6.95	7.7	7.7	6.5	9.4	9.95	8.0	6.8	6.8	6.9
25	7.3	7.3	6.85	8.15	7.6	6.45	8.45	10.3	7.85	6.8	6.75	6.8
26	7.3	7.3	6.8	8.7	7.65	6.3	9.95	10.45	7.75	6.8	6.7	6.8
27	7.3	7.3	6.8	8.8	7.75	6.25	11.2	10.5	7.6	6.8	6.7	6.8
28	7.3	7.25	7.0	8.55	8.3	6.15	10.45	10.2	7.55	6.8	6.7	6.75
29	7.3	7.2	7.35	8.35	8.6	6.1	9.85	10.3	7.5	6.8	6.7	6.75
30	7.3	.....	7.3	8.35	8.75	6.4	9.5	10.3	7.5	6.8	6.7	6.75
31	7.3	.....	7.2	.....	8.75	.....	9.55	13.1	.....	6.8	.....	6.7

Daily discharge, in second-feet, of Rio Grande below Presidio, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1,160	a1,540	950	1,560	3,780	4,290	7,500	a5,530	9,480	3,790	2,390	18,210
2	a1,150	1,350	935	1,640	3,610	a4,940	a7,650	5,300	10,080	3,030	2,850	14,710
3	1,130	1,330	920	a1,560	a3,440	4,770	8,100	5,370	a11,710	a2,600	a2,570	a9,780
4	1,190	a1,270	a900	1,600	2,680	4,770	8,550	a5,430	11,890	2,440	2,730	7,330
5	a1,100	1,210	870	1,570	2,370	a5,640	5,980	5,120	12,270	2,330	a6,410	6,880
6	1,090	1,200	a875	a1,450	a2,510	6,020	a5,850	4,780	a11,330	a2,380	18,880	a6,720
7	1,080	a1,190	905	1,290	3,050	6,390	5,800	4,440	11,400	2,330	20,500	6,120
8	a1,070	1,190	1,060	1,210	3,140	a7,130	5,880	a3,760	15,840	2,170	a12,920	5,820
9	1,260	1,140	a1,050	a1,060	a2,920	7,290	a5,360	4,040	a13,880	a1,850	7,820	a5,520
10	1,310	a1,090	1,000	1,000	2,710	6,520	5,700	a4,330	10,420	1,690	6,430	5,010
11	a1,360	1,360	950	940	2,650	a6,060	a6,200	4,190	10,150	1,310	a6,120	4,930
12	1,270	1,360	a900	a915	a2,600	5,530	6,310	4,190	a10,480	a1,310	4,890	a4,640
13	1,180	a1,250	900	835	2,460	5,450	6,120	a3,360	8,300	1,190	4,430	4,190
14	1,160	1,190	895	915	2,600	a5,510	a6,090	3,170	7,920	950	a4,130	3,750
15	a1,000	1,170	890	a915	a2,460	5,660	6,730	2,720	a7,660	830	3,630	a3,300
16	1,130	a1,130	a855	915	2,160	6,230	7,050	2,010	8,540	a1,900	2,850	3,160
17	a1,210	1,140	705	915	2,260	a6,650	a6,570	a1,680	9,420	1,470	a2,820	3,020
18	1,450	1,130	a585	a870	2,230	7,660	5,470	1,680	a14,360	a1,270	2,740	a2,740
19	1,450	a1,110	585	820	a1,950	7,890	5,030	a2,000	13,030	970	2,660	2,610
20	a1,330	1,120	625	900	1,970	a8,000	a4,280	1,760	10,900	2,080	a2,520	2,340
21	1,410	1,070	a660	1,540	a2,140	7,600	4,170	1,840	a12,580	a5,560	2,520	a2,130
22	1,710	a1,080	660	a2,040	2,310	7,440	4,060	a1,840	10,680	4,080	2,520	2,130
23	a1,590	1,070	660	2,900	2,630	a7,440	4,250	1,680	9,840	3,540	a2,350	2,050
24	1,540	1,050	a665	a3,530	a2,500	7,110	a4,290	8,750	a9,520	a2,820	2,230	a2,050
25	1,640	a1,000	590	3,860	2,510	6,930	4,260	a6,570	8,600	2,190	2,270	1,970
26	a2,240	970	515	4,080	2,660	a6,990	a4,230	5,840	8,120	2,060	2,010	1,880
27	2,440	970	480	a4,080	a3,130	7,220	4,180	5,340	a8,250	a2,190	a2,360	a1,880
28	2,360	970	a440	4,480	3,410	7,220	5,390	a5,280	6,520	2,430	3,110	1,790
29	a1,980	.....	440	4,550	3,680	a7,220	a5,250	5,430	5,650	2,790	3,270	1,700
30	2,060	.....	485	a4,400	3,810	7,690	6,000	5,980	a4,930	3,740	a15,650	1,530
31	2,060	.....	a1,060	.....	a4,210	.....	5,550	a8,600	.....	a2,790	.....	a1,530
1908.												
1	1,360	800	705	830	1,810	2,670	680	3,200	21,900	790	430	380
2	1,360	800	705	700	1,730	a1,630	360	3,500	a18,650	760	a460	380
3	1,350	a800	a655	a610	1,670	1,440	a1,820	5,140	18,950	a680	440	a385
4	a1,340	785	710	610	a1,590	1,320	1,060	a5,240	20,750	635	420	390
5	1,370	775	655	560	1,490	a1,130	620	4,990	a20,550	635	a395	395
6	1,400	a765	710	a535	1,420	1,050	a220	3,760	14,050	a590	395	a400
7	a1,430	730	a770	495	1,310	1,020	185	a3,910	6,850	605	390	405
8	1,310	735	770	480	a1,270	a935	125	4,800	a4,940	575	a385	405
9	a1,180	a775	a620	465	1,270	895	a125	6,400	6,740	a630	385	a405
10	1,180	770	620	a450	1,210	920	115	15,100	a9,190	630	380	415
11	1,170	765	645	480	1,270	a880	100	34,000	8,820	555	a380	425
12	a1,240	a760	a645	660	a1,630	820	a90	25,600	7,080	a555	380	a430
13	1,310	760	615	620	1,630	820	90	15,640	a6,450	555	385	430
14	1,240	960	650	a620	a1,500	a805	85	a4,760	6,030	555	385	445
15	a1,170	950	a650	505	1,320	640	a80	3,110	5,030	a500	a390	a495
16	1,240	950	620	a420	1,140	490	80	a2,970	4,530	525	395	515
17	1,240	a950	620	420	a1,100	a350	a185	2,810	a3,890	550	405	565
18	1,140	1,030	a595	410	1,030	340	a35	2,590	3,740	575	a420	a615
19	a1,090	1,030	565	a395	1,140	325	30	a2,440	3,590	a600	420	610
20	1,090	a1,030	580	570	a1,090	a285	75	2,640	a3,330	560	420	605
21	1,090	955	a580	595	1,090	280	a230	2,840	2,660	490	a425	a630
22	a1,000	880	595	a620	1,200	280	230	a3,400	1,990	a420	450	640
23	990	a880	620	770	a1,040	a270	a8,980	3,210	a1,520	430	475	650
24	a980	880	565	770	1,040	250	a1,980	3,110	1,410	445	a495	a660
25	905	875	a510	1,440	1,070	230	1,220	a3,540	1,230	a455	475	665
26	905	875	495	a2,550	a1,190	a165	3,820	3,560	a1,130	455	455	690
27	905	a870	510	2,690	1,300	135	a5,990	3,390	1,000	455	a455	a720
28	a905	845	a645	2,140	1,910	75	4,640	a2,600	960	a460	425	685
29	890	a815	895	1,680	2,240	a45	3,560	2,980	915	440	400	665
30	875	.....	860	a1,630	2,410	225	a2,930	3,180	a915	420	a375	645
31	a860	.....	a790	.....	2,410	.....	3,200	a11,880	.....	a405	.....	a610

a Dates of measurement.

Monthly discharge of Rio Grande below Presidio, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	2,440	1,000	1,455	89,474
February	1,540	970	1,166	64,760
March	1,060	440	775	47,623
April	4,550	820	1,945	115,716
May	4,210	1,950	2,792	171,650
June	8,000	4,290	6,509	387,292
July	8,550	4,060	5,737	352,760
August	8,750	1,680	4,258	261,838
September	15,840	4,930	10,125	602,479
October	5,560	830	2,325	142,969
November	20,500	2,010	5,286	314,539
December	18,210	1,530	4,562	280,502
The year	20,500	440	3,911	2,831,602
1908.				
January	1,430	860	1,146	70,443
February	1,030	730	855	49,180
March	895	495	651	40,007
April	2,690	395	857	51,015
May	2,410	1,030	1,436	88,304
June	2,670	45	691	41,098
July	8,980	30	1,385	85,170
August	34,000	2,440	6,332	389,335
September	21,900	915	6,960	414,129
October	790	405	546	33,590
November	495	375	416	24,774
December	720	380	528	32,440
The year	34,000	30	1,817	1,319,485

RIO GRANDE NEAR LANGTRY, TEX.

This station was established in April, 1900, by the International Boundary Commission. It is located one-half mile south of Langtry station, on the Southern Pacific Railroad, and is about 440 miles below El Paso, Tex., at the east end of the canyon section of the Rio Grande, and a short distance to the west of the mouth of Pecos River, one of the principal tributaries of the Rio Grande.

The right (Mexican) bank is a rock bluff; the left bank is alluvial deposit for 200 feet back to a rock bluff. As the river is constantly shifting, because of alluvial deposits, frequent discharge measurements are made in order to determine closely the daily flow.

Observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande near Langtry, Tex., in 1907.

[By E. E. Winter, D. J. Smith, I. P. Whitis, and W. H. Dodd.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	771	1.65	1,913	July 2	1,400	4.4	6,690
January 7	781	1.55	1,834	July 8	1,264	3.7	5,670
January 11	794	1.55	1.891	July 14	1,222	3.7	5,554
January 15	786	1.55	1.931	July 18	1,216	3.7	5,845
January 19	795	1.45	1,880	July 25	1,171	3.4	5.571
January 24	816	1.5	1,954	July 30	1,226	3.6	5,750
January 28	817	1.6	2,015	August 2	1,211	3.6	5,454
February 3	726	1.9	1,839	August 8	1,098	3.2	4,612
February 7	697	1.6	1,600	August 12	1,048	3.0	4,287
February 11	676	1.6	1,573	August 16	1,045	3.0	4,255
February 14	665	1.6	1,582	August 21	768	1.9	2,108
February 17	678	1.55	1,548	August 24	776	1.9	2,153
February 21	695	1.55	1,489	August 28 [a]	1,238	3.6	6,359
February 25	703	1.55	1,577	September 5	1,708	5.2	9,053
March 2	608	1.4	1,390	September 8	1,819	5.8	10,475
March 7	647	1.3	1,438	September 13	1,559	5.25	8,323
March 11	581	1.3	1,317	September 20	2,386	7.5	15,307
March 15	631	1.3	1,390	September 23	1,887	5.75	12,176
March 19	646	1.4	1,476	September 27	1,579	4.8	9,221
March 23	599	1.2	1,178	October 2	1,263	3.6	5,665
March 28	596	1.1	1,096	October 7	997	3.2	4,243
April 2	604	0.9	1,024	October 11	730	2.1	2,425
April 6	700	1.7	1,537	October 16	654	1.8	1,971
April 11	706	1.7	1,595	October 21	637	1.7	1,872
April 15	671	1.5	1,429	October 25	964	2.9	3,823
April 18	656	1.3	1,293	October 29	757	2.0	2,597
April 23	671	1.3	1,241	November 2	1,003	3.0	4,091
April 28	1,086	2.8	2,760	November 7	834	2.4	2,825
May 2	1,137	3.0	3,396	November 10	1,952	6.1	12,235
May 7	1,045	2.6	2,944	November 14	1,120	3.8	5,681
May 11	1,055	2.65	2,929	November 18	925	3.05	4,083
May 16	1,051	2.6	2,949	November 22	813	2.7	3,359
May 20	1,018	2.4	2,838	November 28	725	2.3	2,799
May 24	980	2.3	2,577	December 2	752	2.5	2,923
May 28	1,018	2.35	2,731	December 9	1,305	4.3	6,556
June 8	1,227	3.7	5,703	December 13	1,164	3.8	5,585
June 11	1,357	4.3	6,301	December 17	1,012	3.2	4,162
June 15	1,210	3.7	5,662	December 21	858	2.7	3,287
June 18	1,402	4.8	6,606	December 24	790	2.5	2,849
June 22	1,920	5.65	7,264	December 29	724	2.3	2,461
June 27	1,337	4.2	5,809				

[a] Measurement too large. Rejected.

Discharge measurements of Rio Grande near Langtry, Tex., in 1908.

[By W. H. Dodd and E. E. Winter.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	680	2.1	2,233	July 2	363	.5	621
January 7	622	1.9	1,936	July 7	1,788	5.25	10,010
January 11	609	1.8	1,838	July 12	417	.8	911
January 15	624	1.8	1,810	July 16	348	.5	603
January 19	590	1.7	1,684	July 20	392	.4	682
January 23	587	1.65	1,623	July 25	1,306	4.0	6,070
January 28	526	1.5	1,416	July 29	1,468	4.4	8,683
February 1	523	1.4	1,327	August 3	1,200	3.0	4,800
February 5	526	1.4	1,302	August 7	2,172	6.95	15,986
February 10	523	1.4	1,339	August 12	2,458	8.5	19,318
February 14	499	1.25	1,214	August 15	2,888	9.25	23,100
February 20	557	1.5	1,454	August 20	1,229	3.95	6,253
February 27	513	1.3	1,277	August 25	1,225	3.95	6,424
March 1	501	1.25	1,207	August 28	1,302	4.25	7,617
March 5	473	1.1	1,059	September 3	2,783	9.0	21,867
March 10	451	1.0	953	September 7	2,709	8.85	19,492
March 14	468	1.1	996	September 11	1,517	5.0	9,280
March 20	440	1.0	915	September 15	1,557	5.0	9,449
March 24	443	.95	938	September 19	1,093	3.4	4,796
March 29	428	.9	897	September 23	834	2.55	2,879
April 3	511	1.25	1,276	September 27	743	2.0	2,224
April 8	472	1.1	1,128	October 2	674	1.6	1,563
April 12	469	1.0	1,033	October 7	686	1.65	1,589
April 16	620	1.7	1,675	October 12	511	1.0	1,143
April 20	491	1.2	1,014	October 16	498	.9	1,071
April 24	413	.8	796	October 20	464	.8	990
April 27	454	.9	928	October 24	444	.7	826
May 2	710	2.0	2,329	October 28	431	.6	806
May 7	598	1.8	1,668	November 2	417	.5	760
May 11	553	1.7	1,530	November 6	420	.5	766
May 16	562	1.7	1,623	November 10	414	.5	753
May 19	580	1.5	1,626	November 14	412	.45	748
May 23	558	1.4	1,503	November 19	404	.45	748
May 28	528	1.3	1,361	November 23	404	.45	711
June 2	681	2.0	2,213	November 27	405	.45	717
June 6	611	1.9	1,728	December 2	393	.4	675
June 11	593	1.2	1,451	December 7	392	.4	669
June 15	512	1.0	1,181	December 12	397	.4	702
June 19	419	.8	756	December 17	392	.4	667
June 23	380	.5	676	December 22	387	.35	668
June 27	494	.9	1,120	December 28	378	.4	716

Daily gage height, in feet, of Rio Grande near Langtry, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.7	2.0	1.4	1.05	3.2	2.85	4.4	3.7	3.35	3.9	2.55	2.55
2	1.6	1.9	1.4	.9	2.95	3.1	4.45	3.65	3.85	3.55	3.0	4.55
3	1.6	1.9	1.4	.9	2.8	3.0	4.45	3.45	4.8	3.3	2.8	8.15
4	1.6	1.9	1.4	1.1	2.8	3.15	4.2	3.3	4.9	3.05	2.85	5.75
5	1.55	1.8	1.35	1.55	2.75	3.4	3.95	3.4	5.4	3.2	2.75	5.1
6	1.55	1.8	1.3	1.7	2.7	3.5	3.9	3.5	6.15	2.85	2.5	4.7
7	1.55	1.6	1.3	1.8	2.6	3.6	3.75	3.4	5.85	3.0	2.4	4.5
8	1.55	1.55	1.3	1.8	2.5	3.75	3.7	3.25	5.8	2.85	7.3	4.35
9	1.55	1.55	1.3	1.75	2.45	3.95	3.6	2.95	6.1	2.45	9.95	4.3
10	1.55	1.6	1.3	1.7	2.45	4.35	3.6	2.9	7.05	2.15	6.25	4.3
11	1.55	1.6	1.3	1.7	2.7	4.3	3.6	2.85	7.6	2.05	5.35	4.15
12	1.6	1.6	1.3	1.7	2.75	3.95	3.8	2.85	6.7	2.0	4.5	3.95
13	1.6	1.6	1.3	1.7	2.6	3.7	3.7	2.8	5.25	1.9	4.05	3.85
14	1.6	1.6	1.3	1.6	2.55	3.7	3.7	2.8	4.75	1.85	3.85	3.65
15	1.55	1.55	1.3	1.5	2.6	3.7	3.7	2.8	4.6	1.9	3.55	3.45
16	1.55	1.55	1.3	1.45	2.55	3.7	3.7	3.0	4.5	1.85	3.35	3.3
17	1.55	1.55	1.3	1.3	2.3	3.85	3.7	2.6	4.8	1.7	3.15	3.2
18	1.5	1.55	1.35	1.3	2.2	5.0	3.6	2.45	4.65	2.05	3.05	3.1
19	1.45	1.55	1.35	1.3	2.2	4.7	3.6	2.3	5.0	2.1	3.0	2.95
20	1.45	1.55	1.3	1.3	2.6	4.6	3.5	2.2	7.75	1.95	2.9	2.9
21	1.4	1.55	1.15	1.35	2.6	4.55	3.45	1.95	6.55	1.75	2.85	2.7
22	1.4	1.55	1.2	1.3	2.4	5.5	3.35	1.95	6.6	1.85	2.75	2.7
23	1.4	1.55	1.15	1.3	2.35	4.65	3.2	1.9	5.5	1.7	2.6	2.5
24	1.5	1.55	1.15	1.4	2.3	4.25	3.4	1.9	4.9	3.0	2.55	2.5
25	1.65	1.55	1.1	1.8	2.4	4.0	3.4	1.9	4.95	2.85	2.5	2.5
26	1.7	1.55	1.2	2.25	2.5	4.05	3.5	3.9	4.75	2.7	2.45	2.4
27	1.6	1.5	1.45	2.55	2.4	4.25	3.2	3.5	4.7	2.5	2.4	2.4
28	1.6	1.45	1.15	2.85	2.35	4.25	4.15	3.4	4.75	2.35	2.3	2.3
29	1.65	.....	1.1	3.1	2.4	4.2	3.4	3.3	4.6	2.1	2.55	2.3
30	2.2	.....	1.1	3.2	2.5	4.2	3.6	3.3	4.25	2.05	2.65	2.2
31	2.15	.....	1.1	.....	2.55	.....	3.65	3.3	.....	2.05	.....	2.1
1908.												
1	2.1	1.4	1.25	.9	2.0	1.75	.5	3.75	5.0	1.65	.5	.45
2	2.0	1.4	1.25	.95	2.0	1.95	.5	3.25	7.7	1.6	.5	.45
3	2.0	1.4	1.2	1.25	2.05	2.2	.5	2.95	9.0	1.55	.5	.45
4	2.0	1.4	1.2	1.25	2.05	2.15	.5	2.6	8.85	1.45	.5	.45
5	1.9	1.4	1.1	1.2	1.95	2.05	.45	2.5	8.1	1.35	.5	.45
6	1.9	1.4	1.1	1.2	1.9	1.9	.35	5.15	9.05	1.3	.5	.4
7	1.9	1.35	1.1	1.05	1.8	1.8	4.95	6.55	8.5	1.5	.5	.4
8	1.9	1.35	1.1	1.05	1.65	1.75	1.8	4.9	7.45	1.6	.5	.4
9	1.85	1.4	1.1	1.05	1.6	1.6	1.45	4.3	5.7	1.25	.5	.4
10	1.8	1.4	1.05	.95	1.55	1.4	1.35	4.15	5.15	1.15	.5	.4
11	1.8	1.55	1.0	.95	1.65	1.2	1.25	4.15	5.15	1 05	.45	.4
12	1.8	1.5	1.15	1.0	1.45	1.05	.85	7.8	6.45	1.0	.45	.4
13	1.8	1.4	1.2	.95	1.3	1.0	.75	11.25	6.15	1.0	.45	.35
14	1.8	1.25	1.1	1.25	1.2	1.0	.65	12.3	5.85	.95	.45	.35
15	1.8	1.25	1.1	1.1	1.1	1.0	.55	8.9	4.95	.95	.45	.35
16	1.8	1.25	1.05	1.45	1.75	.95	.5	6.1	4.35	.9	.45	.35
17	1.7	1.25	1.1	1.6	1.9	.9	.4	5.3	3.95	.9	.45	.35
18	1.7	1.3	1.05	2.1	1.8	.8	.4	4.9	3.6	.9	.45	.35
19	1.7	1.5	1.0	1.8	1.5	.8	.4	4.45	3.3	.85	.45	.35
20	1.7	1.5	1.0	1.45	1.4	.75	.4	4.0	3.05	.8	.45	.35
21	1.7	1.4	1.05	1.1	1.4	.7	3.1	3.95	2.85	.8	.45	.35
22	1.7	1.4	1.0	.95	1.4	.6	1.75	3.95	2.65	.75	.45	.35
23	1.65	1.5	1.0	.95	1.4	.5	.9	3.95	2.55	.7	.45	.35
24	1.6	1.5	.95	.85	1.4	2.65	3.4	3.95	2.4	.7	.45	.35
25	1.6	1.5	.95	.8	1.4	2.05	4.55	4.4	2.25	.7	.45	.35
26	1.6	1.4	.95	.8	1.4	1.65	3.5	4.85	2.05	.7	.45	.35
27	1.55	1.3	.9	.85	1.3	.95	2.45	4.35	2.05	.65	.45	.35
28	1.5	1.3	.9	.9	1.3	1.0	2.65	4.35	1.9	.6	.45	.4
29	1.5	1.3	.9	1.1	1.3	.75	4.45	4.55	1.8	.6	.45	.4
30	1.5	.....	.9	2.0	1.3	.55	4.0	4.65	1.7	.6	.45	.35
31	1.4	.....	.9	.....	1.35	.....	3.85	4.9	.....	.5	.....	.35

Daily discharge, in second-feet, of Rio Grande near Langtry, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2,010	2,370	1,430	1,080	3,480	3,740	6,450	5,790	4,930	6,800	3,410	3,040
2	1,880	2,040	a1,390	a1,020	a3,340	4,320	a6,760	a 5,550	6,050	a5,660	a 4,090	a 8,150
3	a1,866	a1,840	1,420	1,020	3,170	4,090	6,760	5,140	8,160	4,940	3,670	17,360
4	1,870	1,840	1,440	1,150	[illegible]170	4,430	6,400	4,820	8,390	4,320	3,770	10,610
5	1,840	1,760	1,430	1,440	[illegible]110	5,010	6,030	5,030	a 9,530	4,490	3,560	8,790
6	1,830	1,760	1,420	a1,540	3,060	5,240	5,960	5,240	11,300	3,670	3,040	7,670
7	a1,830	a1,600	a1,440	1,620	a2,940	5,470	5,740	5,030	10,590	a3,840	a 2,830	7,110
8	1,850	1,550	1,410	1,630	2,800	a5,750	a5,670	a 4,720	a10,480	3,670	15,280	6,690
9	1,860	1,550	1,380	1,610	2,720	5,950	5,560	4,200	11,330	3,010	22,010	a 6,560
10	1,880	1,580	1,350	1,580	2,700	6,350	5,540	4,120	14,020	2,510	a12,620	6,560
11	a1,890	a1,570	a1,320	a1,590	a3,000	a6,300	5,520	4,040	15,610	a2,350	10,100	6,260
12	1,940	1,580	1,330	1,600	3,070	5,930	5,680	a 4,040	12,830	2,270	7,680	5,880
13	1,950	1,580	1,350	1,600	2,950	5,660	5,570	3,970	a 8,320	2,120	6,390	a 5,680
14	1,960	a1,580	1,370	1,510	2,910	5,660	a5,550	3,970	7,320	2,050	a 5,820	5,230
15	a1,930	1,550	a1,390	a1,430	2,950	a5,660	5,630	3,970	a 7,020	2,120	5,150	4,760
16	1,930	1,550	1,390	1,390	a2,900	5,660	5,700	a 4,260	6,820	a2,050	4,720	4,400
17	1,930	a1,550	1,390	1,290	2,650	5,790	5,770	3,470	7,670	1,820	4,300	a 4,160
18	1,900	1,530	1,430	a1,290	2,550	a6,760	a5,750	3,180	7,240	2,350	a 4,080	3,990
19	a1,880	1,520	a1,430	1,280	2,550	6,530	5,750	2,890	8,240	2,420	3,980	3,720
20	1,890	1,500	1,360	1,270	a3,080	6,450	5,660	2,700	a16,060	2,210	3,770	3,640
21	1,850	a1,490	1,210	1,290	3,080	6,410	5,620	a 2,210	13,610	a1,940	3,670	a 3,290
22	1,860	1,510	1,210	1,250	2,740	a7,150	5,530	2,220	13,700	2,120	a 3,460	3,290
23	1,870	1,530	a1,140	a1,240	2,660	6,260	5,390	2,140	a11,400	1,870	3,220	2,850
24	a1,950	1,550	1,140	1,340	a2,580	5,860	5,570	a 2,150	9,540	3,990	3,150	2,850
25	2,050	a1,570	1,100	1,750	2,740	5,610	a5,570	2,150	9,690	a3,760	3,080	a 2,850
26	2,080	1,570	1,180	2,200	2,900	5,660	5,660	6,080	9,060	3,550	3,010	2,660
27	2,010	1,540	1,380	2,500	2,780	a5,860	5,390	5,240	a 8,910	3,280	2,940	2,660
28	a2,010	1,510	a1,140	a2,810	a2,730	5,860	6,250	5,030	9,120	3,070	a 2,800	2,460
29	2,080	.....	1,100	3,180	2,810	5,810	5,570	4,820	8,820	a2,730	3,150	a 2,460
30	2,850	.....	1,100	3,330	2,970	5,810	a5,750	4,820	8,120	2,660	3,290	2,280
31	2,780	.....	1,100	.....	3,050	.....	5,790	4,820	.....	2,660	.....	2,100
1908.												
1	2,170	a1,330	a1,210	895	2,210	1,900	650	7,010	9,740	1,710	710	695
2	a2,110	1,320	1,210	950	a2,330	a2,150	a 620	5,530	17,920	a1,560	a 760	a 675
3	2,100	1,320	1,160	a1,280	2,380	2,540	620	a 4,700	a21,870	1,540	760	675
4	2,090	1,310	1,160	1,280	2,330	2,370	620	4,000	20,940	1,490	760	675
5	1,960	a1,300	a1,060	1,230	2,080	2,100	570	3,800	18,200	1,430	765	675
6	1,950	1,310	1,050	1,230	1,920	a1,730	470	11,060	20,570	1,410	a 765	670
7	a1,940	1,280	1,050	1,080	a1,670	1,690	a9,290	a14,870	a18,560	a1,490	765	a 670
8	1,940	1,280	1,040	a1,080	1,460	1,670	2,000	10,250	15,780	1,550	760	670
9	1,890	1,330	1,040	1,080	1,390	1,610	1,620	8,570	11,140	1,310	760	670
10	1,830	a1,340	a 990	985	1,320	1,530	1,510	8,150	9,680	1,240	a 755	670
11	a1,840	1,460	940	985	a1,460	a1,450	1,400	8,150	a 9,730	1,170	750	670
12	1,830	1,420	1,050	a1,030	1,220	1,250	a 970	a17,520	13,630	a1,140	750	a 670
13	1,820	1,340	1,090	985	1,040	1,180	860	27,570	12,770	1,140	750	660
14	1,820	a1,210	a1,000	1,260	930	1,180	755	30,700	11,900	1,110	a 750	660
15	a1,810	1,210	1,000	1,120	820	1,180	655	a21,990	a 9,300	1,110	750	660
16	1,810	1,210	960	1,450	a1,700	1,080	a 605	13,080	7,560	a1,070	750	665
17	1,680	1,210	1,000	1,540	1,940	970	565	10,540	6,390	1,070	745	a 665
18	1,680	1,260	960	2,200	1,860	800	600	9,270	5,380	1,070	745	665
19	a1,680	1,450	920	1,810	a1,630	a 755	640	7,840	a 4,570	1,070	a 745	670
20	1,680	a1,450	a 910	a1,340	1,530	745	a 680	a6,410	4,010	a1,030	740	670
21	1,680	1,370	970	960	1,520	730	4,130	6,290	3,560	970	730	670
22	1,680	1,370	945	875	1,510	700	1,970	6,320	3,110	950	720	a 670
23	a1,620	1,450	965	875	a1,500	a 675	1,120	6,350	a 2,880	885	a 710	670
24	1,560	1,450	a 940	a 820	1,490	3,060	4,870	6,390	2,700	a 825	710	670
25	1,550	1,450	940	780	1,480	2,400	a7,450	a 7,770	2,520	825	710	670
26	1,550	1,370	940	760	1,470	1,950	5,070	9,120	2,280	825	715	670
27	1,480	a1,280	895	a 790	1,360	a1,170	4,020	a 7,860	a 2,220	815	a 715	670
28	a1,420	1,280	895	930	a1,360	1,230	4,320	7,860	2,100	a 805	715	a 715
29	1,420	1,280	a 895	1,140	1,360	955	a8,800	8,460	1,980	785	720	715
30	1,420	.....	895	2,100	1,360	735	7,680	8,740	1,860	765	720	670
31	1,320	.....	895	.....	1,410	.....	7,310	9,440	.....	a 675	.....	670

a Dates of measurement.

Monthly discharge of Rio Grande near Langtry, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	2,850	1,830	1,977	121,587
February	2,370	1,490	1,631	90,585
March	1,440	1,100	1,312	80,668
April	3,330	1,020	1,628	96,853
May	3,480	2,550	2,908	178,790
June	7,150	3,740	5,701	339,253
July	6,760	5,390	5,792	356,112
August	6,080	2,140	4,123	253,507
September	16,060	4,930	9,796	582,902
October	6,800	1,820	3,106	191,008
November	22,010	2,800	5,401	321,401
December	17,360	2,100	5,162	317,375
The year	22,010	1,020	4,045	2,930,041
1908.				
January	2,170	1,320	1,753	107,762
February	1,460	1,210	1,332	76,641
March	1,210	895	999	61,438
April	2,200	760	1,161	69,104
May	2,380	820	1,582	97,269
June	3,060	675	1,449	86,251
July	9,290	470	2,659	163,517
August	30,700	3,800	10,181	626,003
September	21,870	1,860	9,162	545,157
October	1,710	675	1,124	69,094
November	765	710	740	44,033
December	715	660	673	41,375
The year	30,700	470	2,735	1,987,644

RIO GRANDE BELOW MOUTH OF DEVILS RIVER, TEX.

The station was established in April, 1900, by the International Boundary Commission. It is alongside the Southern Pacific Railroad track, about a mile below the mouth of Devils River and about 480 miles below El Paso.

The bed of the river is rock for a short distance from the left bank; the right bank is alluvial deposit, overflowing in extreme high water for a distance of some 500 feet back from the river. The left bank is a loose rock fill, along which runs the Southern Pacific Railroad.

Frequent discharge measurements are made to determine closely the daily flow. The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

24440—IRR 248—10——5

Discharge measurements of Rio Grande below mouth of Devils River, Tex., in 1907.

[By E. E. Winter, D. J. Smith, I. P. Whitis, and W. H. Dodd.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	1,419	4.0	3,416	June 30	1,694	5.9	7,356
January 10	1,368	3.9	3,043	July 4	1,936	5.9	8,800
January 14	1,371	3.9	3,066	July 10	1,733	5.4	7,844
January 18	1,414	4.0	3,354	July 15	1,863	5.7	8,418
January 23	1,411	4.0	3,359	July 19	1,714	5.4	7,709
January 26	1,401	4.0	3,363	July 24	1,635	5.1	6,030
January 31	1,416	4.05	3,460	July 28	1,866	5.8	8,337
February 9	1,300	3.9	2,898	August 5	1,593	5.2	6,335
February 13	1,301	3.8	2,742	August 10	1,556	5.0	6,119
February 16	1,286	3.7	2,718	August 14	1,290	4.4	4,256
February 19	1,323	3.8	2,778	August 19	1,251	4.3	4,028
February 23	1,262	3.8	2,660	August 22	1,212	4.4	3,349
February 28	1,266	3.7	2,626	August 25	1,208	4.4	3,309
March 5	1,284	3.6	2,620	August 31 [a]	1,539	5.0	4,473
March 10	1,262	3.7	2,511	September 7	2,393	6.8	13,300
March 14	1,226	3.7	2,506	September 11	3,000	7.6	18,679
March 18	1,204	3.5	2,441	September 21	2,777	7.6	17,482
March 21	1,206	3.4	2,481	September 30	1,875	6.0	9,190
March 27	1,142	3.4	2,149	October 5	1,603	5.4	6,715
March 31	1,135	3.4	2,179	October 10	1,271	4.7	4,203
April 5	1,178	3.1	2,072	October 14	1,154	4.5	3,326
April 10	1,323	3.7	2,502	October 18	1,044	4.4	3,201
April 14	1,212	3.5	2,284	October 23	1,226	4.5	3,334
April 17	1,219	3.55	2,332	October 27	1,450	5.0	4,969
April 21	1,217	3.4	2,428	October 31	1,390	4.9	4,475
April 26	1,180	3.2	2,108	November 5	1,609	5.5	7,053
April 30	1,584	4.75	4,018	November 9	3,630	8.8	21,852
May 4	1,489	4.5	3,506	November 13	1,843	6.1	9,160
May 10	1,435	4.2	3,375	November 17	1,602	5.4	6,683
May 15	1,418	4.2	3,340	November 21	1,438	5.1	5,241
May 18	1,374	4.2	3,142	November 26	1,328	4.9	4,656
May 23	1,411	4.1	3,313	November 30	1,431	5.0	5,047
May 27	1,375	4.3	3,366	December 4	2,943	7.4	15,963
May 31	1,425	4.35	3,614	December 11	1,706	6.0	8,312
June 9	1,773	5.4	6,657	December 15	1,587	5.5	6,818
June 13	1,858	5.8	8,308	December 19	1,451	5.2	5,457
June 16	1,785	5.4	7,278	December 23	1,319	4.9	4,679
June 21	1,965	6.1	9,022	December 26	1,338	4.8	4,372
June 25	1,758	6.0	7,430	December 31	1,277	4.7	4,002

[a] Too small, rejected.

Discharge measurements of Rio Grande below mouth of Devils River, Tex., in 1908.

[By W. H. Dodd and E. E. Winter.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	1,262	4.6	3,751	July 6	986	3.6	2,091
January 8	1,230	4.6	3,539	July 10	1,655	5.0	5,158
January 13	1,290	4.5	3,432	July 15	1,040	3.9	2,459
January 16	1,266	4.4	3,366	July 19	996	3.7	2,006
January 20	1,266	4.4	3,244	July 24	1,142	3.95	2,842
January 24	1,275	4.35	3,105	July 27	1,459	5.0	5,357
January 30	1,245	4.3	3,002	July 31	1,735	5.9	8,737
February 3	1,224	4.2	2,689	August 6	2,171	7.0	11,812
February 7	1,229	4.2	2,678	August 10	1,776	6.1	9,747
February 12	1,240	4.2	2,861	August 14	3,168	9.4	22,498
February 16	1,220	4.05	2,553	August 19	1,935	5.95	9,465
February 23	1,268	4.1	2,755	August 23	1,817	5.75	8,043
February 29	1,225	4.0	2,485	August 27	1,917	6.0	10,588
March 4	1,210	4.0	2,325	August 31	2,012	6.25	10,872
March 8	1,185	3.9	2,214	September 5	2,652	8.6	19,667
March 12	1,181	3.9	2,266	September 10	2,176	7.0	12,931
March 17	1,154	3.85	2,044	September 14	2,200	7.0	12,658
March 21	1,135	3.8	2,054	September 18	1,733	5.7	7,874
March 25	1,128	3.75	1,998	September 22	1,453	5.0	5,138
March 31	1,107	3.75	1,909	September 26	1,275	4.7	3,659
April 7	1,147	3.85	2,167	September 30	1,242	4.4	3,392
April 10	1,167	3.95	2,374	October 6	1,026	4.1	2,791
April 15	1,170	3.95	2,263	October 11	999	4.1	2,464
April 18	2,380	7.1	15,018	October 15	966	3.95	2,285
April 23	1,069	4.0	2,362	October 19	949	3.8	2,179
April 26	1,011	3.8	2,131	October 23	931	3.8	2,029
April 30	1,082	4.2	2,518	October 27	918	3.8	1,992
May 6	1,243	4.3	3,129	October 31	909	3.8	1,963
May 9	1,164	4.2	2,678	November 5	912	3.75	1,896
May 14	1,112	4.0	2,274	November 9	901	3.75	1,866
May 18	1,195	4.3	3,138	November 13	923	3.7	1,898
May 22	1,227	3.9	2,967	November 18	896	3.7	1,849
May 27	1,231	4.1	3,212	November 22	889	3.7	1,804
May 31	1,197	3.9	2,736	November 26	893	3.7	1,810
June 5	1,425	4.5	3,903	November 30	928	3.75	1,940
June 9	1,354	4.1	3,318	December 5	905	3.7	1,813
June 14	1,096	3.9	2,306	December 10	927	3.7	1,847
June 18	965	3.7	1,872	December 16	939	3.7	1,854
June 22	982	3.6	1,709	December 21	912	3.7	1,795
June 26	1,200	4.4	3,096	December 27	917	3.7	1,816
June 30	1,077	3.7	2,186	December 31	916	3.7	1,799

Daily gage height, in feet, of Rio Grande below mouth of Devils River, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.0	4.2	3.65	3.3	4.7	4.65	5.9	5.35	5.1	5.75	4.9	5.0
2	4.0	4.3	3.6	3.2	4.7	4.95	5.9	5.5	5.45	5.3	5.2	5.0
3	4.0	4.2	3.6	3.2	4.7	5.0	5.9	5.45	6.6	5.25	5.3	8.3
4	4.0	4.2	3.6	3.2	4.5	5.05	5.9	5.2	6.15	5.1	4.9	7.35
5	3.95	4.2	3.6	3.1	4.5	5.1	6.05	5.15	6.45	5.45	5.55	6.45
6	3.85	4.15	3.6	3.1	4.45	5.15	5.25	5.1	6.75	5.25	5.55	6.2
7	3.9	4.0	3.6	3.7	4.25	5.25	5.2	5.2	6.75	5.1	5.5	6.05
8	3.9	4.0	3.6	3.7	4.25	5.3	5.55	5.25	6.7	5.1	6.65	6.1
9	3.85	3.9	3.65	3.7	4.25	5.45	5.6	5.0	6.7	4.95	8.65	6.0
10	3.85	3.9	3.7	3.7	4.2	5.65	5.4	5.0	6.9	4.7	7.65	5.95
11	3.85	3.9	3.7	3.7	4.2	5.7	5.4	4.8	7.6	4.7	6.95	5.95
12	3.9	3.8	3.7	3.7	4.3	5.8	5.45	4.8	6.95	4.55	6.5	5.9
13	3.9	3.8	3.7	3.5	4.2	5.8	5.65	4.9	6.35	4.5	6.05	5.7
14	3.9	3.8	3.7	3.55	4.2	5.55	5.7	4.4	6.2	4.5	5.85	5.5
15	3.9	3.8	3.7	3.6	4.2	5.4	5.75	4.3	5.4	4.4	5.8	5.5
16	3.95	3.7	3.6	3.5	4.1	5.5	5.6	4.35	5.25	4.5	5.0	5.4
17	3.95	3.9	3.5	3.55	4.15	5.85	5.65	4.25	6.2	4.4	5.35	5.3
18	4.0	3.9	3.5	3.55	4.2	6.85	5.5	4.15	6.05	4.4	5.3	5.2
19	4.0	3.8	3.5	3.4	4.2	6.25	5.4	4.3	5.95	4.4	5.3	5.15
20	4.0	3.9	3.4	3.4	4.1	6.4	5.4	4.35	7.5	4.4	5.2	5.1
21	4.0	3.85	3.4	3.4	4.4	6.05	5.4	4.4	7.55	4.4	5.1	5.1
22	4.0	3.8	3.4	3.4	4.45	6.55	5.3	4.4	7.2	4.4	5.05	5.0
23	4.0	3.8	3.4	3.4	4.1	6.0	5.35	4.4	6.75	4.45	5.0	4.9
24	4.0	3.8	3.4	3.35	3.95	6.0	5.15	4.4	6.35	4.4	5.0	4.9
25	4.0	3.75	3.4	3.2	3.9	5.95	5.1	4.4	6.2	5.05	5.0	4.8
26	3.95	3.7	3.4	3.5	4.1	5.8	5.25	4.4	6.15	5.0	4.9	4.8
27	4.0	3.7	3.4	4.1	4.3	5.85	5.1	5.4	6.1	5.0	4.95	4.8
28	4.0	3.7	3.4	4.3	4.15	5.9	5.8	5.4	6.15	5.0	4.95	4.7
29	4.0	.....	3.4	4.55	4.1	5.9	5.2	5.15	6.05	6.9	4.9	4.7
30	4.0	.....	3.4	4.75	4.1	5.9	5.15	5.1	6.0	4.95	5.0	4.7
31	4.1	.....	3.4	.....	4.5	.....	5.75	5.0	.....	4.9	.....	4.7
1908.												
1	4.7	4.3	4.0	3.7	4.5	3.95	3.7	5.4	6.45	4.25	3.75	3.75
2	4.6	4.2	4.0	3.7	4.5	4.15	3.6	5.2	6.85	4.2	3.75	3.7
3	4.6	4.2	4.0	3.8	4.45	4.35	3.75	4.9	8.2	4.2	3.75	3.7
4	4.6	4.2	4.0	3.9	4.3	4.5	3.65	5.0	8.7	4.15	3.75	3.7
5	4.6	4.2	4.0	3.9	4.3	4.55	3.6	5.25	8.8	4.1	3.75	3.7
6	4.6	4.2	3.9	3.85	4.3	4.55	3.55	6.85	8.25	4.1	3.75	3.7
7	4.6	4.2	3.9	3.85	4.2	4.35	7.8	7.25	8.45	4.5	3.75	3.7
8	4.6	4.1	3.9	3.8	4.2	4.2	5.95	6.45	8.1	4.4	3.75	3.7
9	4.5	4.2	3.9	3.7	4.2	4.1	5.0	5.6	7.4	4.35	3.75	3.7
10	4.5	4.2	3.9	3.95	4.1	4.1	5.0	6.05	6.9	4.15	3.75	3.7
11	4.5	4.2	3.85	3.8	4.1	4.05	4.65	5.95	6.45	4.1	3.7	3.7
12	4.5	4.2	3.9	3.85	4.05	3.9	4.3	6.55	7.0	4.0	3.7	3.7
13	4.5	4.1	3.9	3.9	4.0	4.0	4.1	8.45	7.25	4.0	3.7	3.7
14	4.5	4.1	3.9	4.05	4.0	3.9	4.0	9.45	6.95	4.0	3.7	3.7
15	4.5	4.05	3.9	3.95	3.95	3.9	3.9	9.8	6.65	3.95	3.7	3.7
16	4.4	4.05	3.85	4.1	3.9	3.8	3.8	7.6	6.2	3.9	3.7	3.7
17	4.4	4.05	3.85	4.15	3.9	3.8	3.8	6.6	6.0	3.85	3.7	3.7
18	4.4	4.05	3.8	5.4	4.3	3.7	3.7	6.15	5.65	3.85	3.7	3.7
19	4.4	4.05	3.8	5.4	4.3	3.7	3.7	5.9	5.45	3.8	3.7	3.7
20	4.4	4.1	3.8	4.75	4.05	3.7	3.7	5.75	5.3	3.8	3.7	3.7
21	4.4	4.1	3.8	4.5	3.95	3.7	3.75	5.7	5.2	3.8	3.7	3.7
22	4.4	4.1	3.8	4.15	3.9	3.6	3.85	5.7	5.0	3.8	3.7	3.7
23	4.4	4.1	3.8	4.0	3.95	3.6	4.15	5.75	5.0	3.8	3.7	3.7
24	4.4	4.05	3.8	3.95	5.25	4.35	3.95	5.75	4.85	3.8	3.7	3.7
25	4.35	4.15	3.75	3.95	4.55	4.6	5.0	6.15	4.7	3.8	3.7	3.75
26	4.3	4.1	3.8	3.8	4.15	4.35	6.0	6.4	4.7	3.8	3.7	3.7
27	4.3	4.1	3.8	3.9	4.1	4.2	5.0	5.95	4.7	3.8	3.7	3.7
28	4.3	4.05	3.8	3.9	4.05	4.05	4.35	5.8	4.65	3.8	3.7	3.7
29	4.3	4.0	3.8	4.05	3.95	3.85	4.95	5.75	4.45	3.8	3.75	3.7
30	4.3	.....	3.75	4.25	3.9	3.7	5.9	6.1	4.4	3.8	3.75	3.7
31	4.3	.....	3.75	.....	3.9	.....	5.95	6.4	.....	3.8	.....	3.7

Daily discharge, in second-feet, of Rio Grande below mouth of Devils River, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3,560	3,700	2,620	2,050	3,920	4,480	7,720	6,840	6,150	8,160	4,480	5,050
2	3,520	3,860	2,620	2,020	3,920	5,350	8,080	7,350	7,620	6,310	5,770	5,050
3	3,490	3,650	2,620	2,060	3,920	5,500	8,440	7,180	12,470	6,100	6,190	19,740
4	3,450	3,610	2,620	2,100	a3,510	5,640	a8,800	6,340	10,570	5,480	4,480	a15,760
5	a3,320	3,560	a2,620	a2,070	3,570	5,790	9,090	a6,280	11,830	a6,920	a7,280	11,870
6	3,080	3,440	2,590	2,070	3,550	5,930	7,560	6,220	13,100	6,180	7,280	10,570
7	3,150	3,150	2,560	2,500	3,260	6,220	7,460	6,330	a13,100	5,640	7,050	9,680
8	3,110	3,100	2,530	2,500	3,330	6,370	8,130	6,390	12,630	5,640	12,200	9,590
9	2,980	a2,900	2,520	2,500	3,400	a6,860	8,230	6,120	12,630	5,100	a21,150	8,890
10	a2,940	2,900	a2,510	a2,500	a3,370	7,690	a7,840	a6,120	13,970	a4,200	16,450	8,400
11	2,950	2,900	2,510	2,500	3,370	7,900	7,840	5,480	a18,680	4,200	13,160	a8,160
12	3,050	2,740	2,510	2,500	3,520	8,310	7,940	5,480	15,360	3,550	11,040	8,010
13	3,060	a2,740	2,510	2,280	3,350	a8,310	8,320	5,860	12,300	3,330	a8,890	7,420
14	a3,070	2,740	a2,510	a2,330	3,350	7,670	8,420	a4,260	11,540	a3,330	8,280	6,820
15	3,090	2,740	2,500	2,380	a3,340	7,280	a8,510	4,030	7,460	3,200	8,100	a6,820
16	3,210	a2,720	2,470	2,280	3,130	7,530	8,180	4,140	6,700	3,330	5,270	6,360
17	3,230	3,040	2,440	2,330	3,140	8,400	8,300	3,910	11,060	3,200	a6,440	5,910
18	a3,350	2,990	a2,440	2,390	a3,140	12,000	7,950	3,690	10,370	a3,200	6,200	5,460
19	3,350	a2,780	2,460	2,320	3,140	9,620	a7,710	a4,030	9,910	3,200	6,200	a5,330
20	3,350	2,890	2,460	2,370	3,000	10,220	7,550	3,830	17,030	3,200	5,720	5,200
21	3,350	2,790	a2,480	a2,430	3,600	a8,820	7,400	3,640	a17,260	3,200	a5,240	5,200
22	3,360	2,690	2,430	2,400	3,700	10,520	6,940	a3,350	15,380	3,200	5,100	4,940
23	a3,360	a2,660	2,370	2,360	a3,310	8,030	6,940	3,340	13,020	a3,270	4,950	a4,680
24	3,360	2,680	2,320	2,290	3,100	7,730	a6,180	3,320	10,920	3,200	4,950	4,680
25	3,360	2,630	2,260	2,140	3,030	a7,280	6,030	3,310	10,140	5,130	4,950	4,370
26	a3,260	2,580	2,210	a2,480	3,200	6,870	6,520	3,310	9,880	4,970	a4,660	a4,370
27	3,360	2,600	a2,150	3,210	a3,370	7,070	6,030	6,940	9,620	a4,970	4,850	4,370
28	3,360	a2,630	2,130	3,460	3,170	7,260	a8,340	6,940	9,880	4,970	4,850	4,000
29	3,360	.....	2,110	3,770	3,130	7,310	6,540	6,180	9,350	14,350	4,660	4,000
30	3,360	.....	2,100	a4,020	3,170	a7,360	6,390	6,030	9,190	4,720	a5,050	4,000
31	a3,570	.....	a2,080	.....	a3,910	.....	8,190	5,730	.....	a4,480	.....	a4,000
1908.												
1	4,000	2,960	2,440	1,870	3,190	2,830	2,190	6,940	11,620	3,090	1,900	1,920
2	3,750	2,730	2,400	1,890	3,250	3,220	2,090	6,220	13,120	2,990	1,900	1,860
3	3,750	a2,690	2,360	2,030	3,220	3,610	2,230	5,120	18,170	2,990	1,900	1,840
4	a3,750	2,690	a2,320	2,170	2,990	3,900	2,140	5,440	20,040	2,890	1,900	1,830
5	3,700	2,680	2,320	2,190	3,060	a3,980	2,090	6,240	a20,420	2,790	a1,900	a1,810
6	3,650	2,680	2,210	2,150	a3,130	3,980	a2,040	a11,340	18,190	a2,790	1,890	1,820
7	3,590	a2,680	2,210	a2,170	2,850	3,680	17,200	12,700	19,040	3,590	1,880	1,830
8	a3,540	2,520	a2,210	2,140	2,760	3,470	9,240	10,550	17,560	3,310	1,870	1,830
9	3,360	2,750	2,220	2,040	a2,680	a3,320	5,160	8,590	14,620	3,170	a1,870	1,840
10	3,380	2,790	2,220	a2,370	2,480	3,200	a5,160	a9,550	a12,630	2,610	1,890	a1,850
11	3,400	2,830	2,170	2,140	2,480	2,970	4,300	9,160	11,280	a2,460	1,860	1,850
12	3,420	a2,860	a2,230	2,190	2,380	2,550	3,440	11,470	12,660	2,340	1,880	1,850
13	a3,430	2,660	2,200	2,240	2,280	2,630	2,950	18,830	13,410	2,340	a1,900	1,850
14	3,470	2,660	2,180	2,430	a2,270	a2,310	2,700	a22,750	a12,470	2,340	1,890	1,850
15	3,520	2,550	2,150	a2,260	2,130	2,310	a2,460	24,500	11,370	a2,280	1,880	1,850
16	a3,370	a2,550	2,070	2,470	1,990	2,090	2,230	15,900	9,710	2,250	1,870	a1,850
17	3,340	2,570	a2,040	2,540	1,990	2,090	2,230	12,000	8,980	2,210	1,860	1,840
18	3,300	2,580	2,010	a6,520	a3,140	a1,870	2,010	10,250	a7,680	2,210	a1,850	1,830
19	3,270	2,600	2,020	6,520	3,290	1,870	a2,010	a9,270	6,900	a2,180	1,840	1,820
20	a3,240	2,710	2,040	4,440	2,950	1,870	2,060	8,540	6,310	2,140	1,830	1,810
21	3,230	2,730	a2,050	3,640	2,910	1,870	2,230	8,180	5,920	2,110	1,820	a1,790
22	3,220	2,740	2,050	2,570	a2,970	a1,710	2,510	8,020	a5,140	2,070	a1,810	1,800
23	3,210	a2,760	2,050	a2,360	3,090	1,710	3,220	a8,040	4,990	a2,030	1,810	1,800
24	a3,200	2,640	2,050	2,300	6,310	3,010	a2,840	8,350	4,400	2,020	1,810	1,800
25	3,100	2,830	a2,000	2,300	4,420	3,440	5,360	10,170	3,800	2,010	1,810	1,860
26	3,000	2,720	2,040	a2,130	3,350	a3,030	8,960	11,420	a3,660	2,000	a1,810	1,810
27	3,000	2,710	2,020	2,230	a3,210	2,840	a5,360	a10,020	3,740	a1,990	1,820	a1,820
28	3,000	2,600	2,010	2,230	3,090	2,640	3,540	9,450	3,720	1,980	1,840	1,810
29	3,000	2,480	1,990	2,370	2,850	2,380	5,550	9,260	3,410	1,980	1,940	1,810
30	a3,000	.....	1,920	2,570	2,740	2,190	8,740	10,380	3,390	1,970	a1,940	1,800
31	.....	.....	a1,910	.....	a2,740	.....	a8,900	a11,470	.....	a1,960	.....	a1,800

a Dates of measurement.

Monthly discharge of Rio Grande below mouth of Devils River, Tex., for 1907 and 1908

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	3,570	2,940	3,270	201,064
February	3,860	2,580	2,979	165,441
March	2,620	2,080	2,428	149,276
April	4,020	2,020	2,487	147,987
May	3,920	3,030	3,385	208,106
June	12,000	4,480	7,511	446,916
July	9,090	6,030	7,664	471,212
August	7,350	3,310	5,225	321,263
September	18,680	6,150	11,637	692,469
October	14,350	3,200	4,836	297,382
November	21,150	4,480	7,363	438,129
December	19,740	4,000	7,055	433,785
The year	21,150	2,020	5,487	3,973,030
1908.				
January	4,000	3,000	3,361	206,658
February	2,960	2,480	2,688	154,611
March	2,440	1,910	2,133	131,127
April	6,520	1,870	2,649	157,626
May	6,310	1,990	2,974	182,856
June	3,980	1,710	2,752	163,775
July	17,200	2,010	4,295	264,079
August	24,500	5,120	10,649	654,783
September	20,420	3,390	10,278	611,603
October	3,590	1,960	2,422	148,939
November	1,940	1,810	1,866	111,015
December	1,920	1,800	1,830	112,522
The year	24,500	1,710	3,991	2,899,594

RIO GRANDE AT EAGLE PASS, TEX.

The station was established in April, 1900, by the International Boundary Commission. It is one-half mile above the highway bridge between Eagle Pass, Tex., and Ciudad Porfirio Diaz, Mexico, and about 540 miles below El Paso.

The right bank is alluvial deposit, with a bottom back of it about 1,500 feet wide, which begins to overflow at gage height 22 feet. The left bank is shale rock rising abruptly from the river. The bed of the stream is constantly shifting, and frequent discharge measurements are necessary to determine closely the daily discharge. The section is subject to overflow at high stages. At low water, the depth is considerable and the velocity slow.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1907.

[By J. K. Wilson and E. T. Rucker, jr.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec. ft.*		*Sq. ft.*	*Feet.*	*Sec. ft.*
January 3	2,082	2.8	4,977	July 6	2,372	4.3	9,629
January 6	2,015	2.7	4,375	July 10	2,032	3.8	7,354
January 10	2,007	2.7	4,194	July 13	2,064	3.9	7,683
January 13	2,121	2.7	4,306	July 16	1,954	4.0	7,416
January 16	2,116	2.7	4,284	July 19	2,010	3.9	8,170
January 19	2,115	3.0	4,789	July 22	1,996	3.6	7,404
January 22	2,129	2.9	4,569	July 25	1,814	3.4	6,375
January 25	2,080	2.9	4,443	July 28	1,788	3.3	5,643
January 28	2,083	2.9	4,422	July 31	1,856	3.5	6,873
January 31	2,153	3.2	5,021	August 3	1,803	3.7	7,248
February 3	2,112	3.0	4,556	August 6	1,699	3.3	5,657
February 6	2,121	3.1	4,619	August 9	1,629	3.45	5,523
February 9	1,994	2.8	4,119	August 12	1,464	3.0	4,882
February 12	1,923	2.7	3,787	August 15	1,478	3.0	4,922
February 15	1,877	2.6	3,760	August 18	1,450	3.0	4,853
February 18	1,843	2.6	3,763	August 21	1,368	2.6	4,394
February 21	1,853	2.7	3,907	August 24	1,320	2.5	4,183
February 25	1,832	2.6	3,616	August 27	1,282	2.4	3,880
February 28	1,777	2.5	3,563	August 31	1,469	3.3	5,527
March 3	1,722	2.5	3,128	September 3	1,826	3.7	7,668
March 7	1,690	2.4	3,054	September 6	2,260	4.7	11,869
March 10	1,751	2.5	3,446	September 9	2,370	4.9	12,639
March 13	1,774	2.5	3,435	September 12	2,703	5.55	15,802
March 16	1,710	2.4	3,215	September 15	2,213	4.5	11,296
March 19	1,696	2.3	2,968	September 18	2,357	4.2	9,189
March 22	1,618	2.2	2,838	September 21	3,119	6.05	16,792
March 25	1,632	2.1	2,873	September 24	2,363	5.05	13,001
March 28	1,561	2.1	2,642	September 27	2,260	4.4	9,621
March 31	1,593	2.1	2,640	September 30	2,247	4.3	9,206
April 3	1,551	2.0	2,565	October 3	2,087	3.9	7,906
April 6	1,537	2.0	2,526	October 6	2,410	4.55	10,695
April 9	1,710	2.4	3,231	October 10	1,739	3.2	4,882
April 12	1,667	2.3	3,097	October 13	1,665	2.9	4,704
April 15	1,631	2.2	2,920	October 16	1,613	2.7	4,078
April 18	1,591	2.2	2,661	October 19	1,578	2.7	3,961
April 21	1,570	2.2	2,579	October 22	1,592	2.7	3,847
April 24	1,539	2.2	2,721	October 25	1,495	2.6	3,188
April 27	1,711	2.45	3,475	October 28	1,814	3.35	5,724
April 30	2,050	3.3	5,552	October 31	1,756	3.5	5,842
May 3	1,977	3.4	5,512	November 3	1,905	3.8	6,770
May 6	1,935	3.1	4,799	November 7	2,124	4.0	8,066
May 10	1,906	2.9	4,708	November 9	3,021	6.45	22,559
May 13	1,757	3.0	4,369	November 12	3,131	5.55	12,440
May 16	1,777	2.9	4,617	November 15	2,875	4.3	9,400
May 19	1,751	2.8	4,314	November 18	2,614	3.9	9,957
May 22	1,711	2.8	4,228	November 21	2,086	3.6	6,619
May 25	1,669	2.7	3,838	November 24	1,981	3.4	6,311
May 28	1,838	2.9	5,048	November 27	1,919	3.2	5,956
May 31	1,843	2.9	5,081	November 30	1,975	3.4	6,564
June 3	1,902	3.1	5,406	December 3	1,864	3.5	5,783
June 6	1,853	3.3	5,701	December 5	3,132	5.5	13,656
June 9	1,999	3.6	6,893	December 8	2,756	4.8	12,564
June 12	2,049	3.9	8,066	December 12	2,476	4.4	8,400
June 15	1,984	3.7	6,942	December 15	2,217	4.1	8,433
June 18	2,085	3.85	7,728	December 18	2,037	3.6	7,618
June 21	2,256	4.2	8,511	December 21	1,902	3.5	5,895
June 24	2,385	4.4	10,190	December 24	1,951	3.3	5,967
June 27	2,188	4.1	8,289	December 27	1,847	3.2	5,453
June 30	2,145	4.1	8,045	December 31	1,691	3.1	4,751
July 3	2,326	4.4	9,721				

Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1908.

[By J. K. Wilson.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	1,688	3.0	4,753	July 6	1,818	1.4	2,538
January 6	1,615	2.9	4,366	July 9	1,778	3.3	4,774
January 9	1,604	2.8	4,267	July 12	1,566	2.1	2,351
January 12	1,607	2.7	4,320	July 16	1,499	1.7	2,081
January 15	1,529	2.6	4,024	July 19	1,515	1.7	2,052
January 18	1,477	2.6	3,838	July 22	1,438	1.6	1,854
January 22	1,416	2.5	3,616	July 25	1,577	1.65	2,024
January 25	1,469	2.5	3,757	July 28	1,830	3.0	4,663
January 28	1,500	2.5	3,663	July 31	2,496	4.1	9,067
January 31	1,467	2.5	3,275	August 3	1,668	3.0	4,446
February 3	1,407	2.3	3,066	August 6	3,436	6.7	17,104
February 6	1,348	2.3	2,694	August 10	2,637	4.5	8,633
February 9	1,536	2.5	3,728	August 13	3,158	5.25	12,951
February 12	1,608	2.4	3,510	August 16	4,193	7.4	25,893
February 15	1,535	2.3	3,153	August 19	2,585	4.6	11,921
February 18	1,490	2.2	2,799	August 22	2,485	4.0	8,071
February 21	1,487	2.2	2,836	August 25	2,502	3.9	7,564
February 24	1,500	2.2	3,025	August 28	2,647	4.2	8,500
February 27	1,492	2.1	2,792	August 31	2,746	4.3	8,375
February 29	1,468	2.1	2,710	September 3	3,328	6.15	17,510
March 3	1,456	2.1	2,751	September 6	3,814	6.7	21,680
March 6	1,420	2.1	2,618	September 9	3,683	6.35	18,968
March 10	1,428	1.9	2,568	September 12	2,318	4.8	10,783
March 13	1,350	1.8	2,406	September 15	2,803	5.3	13,389
March 21	1,306	1.7	2,261	September 18	2,197	4.0	8,260
March 24	1,315	1.7	2,232	September 21	2,086	3.3	5,345
March 27	1,298	1.7	2,172	September 24	1,860	2.85	4,584
March 31	1,266	1.7	2,120	September 27	1,773	2.5	4,069
April 3	1,256	1.7	2,121	September 30	1,712	2.3	3,379
April 7	1,291	1.8	2,195	October 3	1,680	2.2	3,252
April 10	1,335	1.8	2,292	October 6	1,639	2.1	3,090
April 13	1,599	2.3	3,340	October 9	1,781	2.3	3,567
April 16	1,441	2.0	2,843	October 13	1,613	1.9	3,314
April 19	2,189	4.4	9,511	October 16	1,427	1.7	2,828
April 22	1,459	2.75	3,691	October 19	1,421	1.6	2,652
April 25	1,396	2.1	3,273	October 22	1,455	1.6	2,738
April 28	1,363	2.0	3,107	October 25	1,371	1.6	2,412
April 30	1,311	2.0	2,874	October 28	1,377	1.6	2,418
May 3	1,460	2.7	3,435	October 31	1,329	1.6	2,311
May 6	1,422	2.5	3,284	November 3	1,325	1.5	2,239
May 9	1,456	2.3	3,424	November 6	1,315	1.5	2,228
May 13	1,480	2.2	3,675	November 9	1,324	1.5	2,234
May 16	1,435	2.0	3,430	November 12	1,360	1.5	2,381
May 19	1,448	2.3	2,941	November 15	1,335	1.5	2,269
May 22	1,352	2.1	2,778	November 18	1,347	1.5	2,355
May 24	5,610	9.8	57,214	November 21	1,355	1.5	2,316
May 25 [a]	3,156	4.5	8,999	November 24	1,363	1.5	2,313
May 28	1,529	2.65	3,522	November 27	1,318	1.5	2,291
May 31	2,388	2.3	4,374	November 30	1,315	1.5	2,276
June 3	1,987	2.3	3,989	December 3	1,302	1.5	2,229
June 6	1,865	2.5	3,809	December 6	1,285	1.5	2,199
June 9	2,006	2.5	4,119	December 9	1,281	1.5	2,156
June 12	1,678	2.2	2,974	December 12	1,265	1.5	2,153
June 15	1,516	2.2	2,718	December 15	1,284	1.4	2,205
June 18	2,012	1.8	2,486	December 18	1,270	1.4	2,251
June 21	1,997	1.7	2,517	December 21	1,264	1.4	2,175
June 24	1,901	1.5	2,112	December 24	1,272	1.4	2,212
June 27	2,183	2.15	3,508	December 27	1,267	1.4	2,212
June 30	2,019	1.7	2,641	December 31	1,264	1.4	2,169
July 3	1,847	1.5	2,736				

[a] Velocity obtained from floats.

Daily gage height, in feet, of Rio Grande at Eagle Pass, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.8	3.0	2.7	2.1	3.35	2.9	4.2	3.6	3.3	4.3	3.5	3.4
2	2.8	3.0	2.6	2.1	3.4	3.0	4.2	3.65	3.35	3.9	3.4	3.4
3	2.8	3.0	2.5	2.0	3.4	3.15	4.4	3.7	4.05	3.9	3.85	4.55
4	2.7	3.0	2.4	2.0	3.3	3.2	4.3	3.35	4.7	3.9	3.85	6.45
5	2.7	3.0	2.4	2.0	3.2	3.3	4.3	3.3	4.3	4.7	3.85	5.4
6	2.7	3.1	2.4	2.0	3.1	3.3	4.3	3.3	4.75	4.4	4.0	5.05
7	2.7	3.0	2.4	2.4	3.0	3.1	4.05	3.35	4.9	3.65	4.0	4.85
8	2.7	2.9	2.4	2.4	3.1	3.5	3.95	3.45	4.8	3.55	4.0	4.75
9	2.7	2.8	2.5	2.4	2.95	3.65	3.8	3.45	5.0	3.45	6.4	4.6
10	2.7	2.9	2.5	2.4	2.9	3.8	3.75	3.25	5.25	3.15	7.4	4.4
11	2.7	2.85	2.4	2.35	2.95	3.9	3.7	3.2	5.6	2.9	6.15	4.3
12	2.7	2.7	2.45	2.25	3.0	3.95	3.8	3.0	5.65	2.9	5.55	4.35
13	2.7	2.7	2.5	2.25	3.0	4.1	4.0	3.0	5.1	2.9	5.0	4.3
14	2.7	2.7	2.5	2.25	2.9	3.9	4.4	3.05	4.6	2.85	4.6	4.2
15	2.7	2.6	2.45	2.2	2.9	3.7	4.2	3.0	4.5	2.8	4.3	4.1
16	2.7	2.6	2.4	2.3	2.9	3.6	3.95	3.0	4.45	2.7	4.3	3.9
17	2.7	2.7	2.4	2.3	2.9	3.7	3.9	3.05	4.25	2.7	4.05	3.8
18	3.0	2.6	2.3	2.2	2.9	3.9	3.95	2.95	4.35	2.7	3.9	3.6
19	3.0	2.65	2.3	2.15	2.8	4.65	3.95	2.9	4.15	2.7	3.7	3.5
20	2.9	2.7	2.25	2.2	3.0	4.25	3.9	2.6	4.1	2.7	3.6	3.5
21	2.9	2.7	2.2	2.2	3.0	4.25	3.7	2.55	6.1	2.7	3.6	3.45
22	2.9	2.7	2.2	2.2	2.8	4.5	3.6	2.5	5.85	2.65	3.6	3.4
23	2.9	2.7	2.15	2.2	2.7	4.65	3.55	2.5	5.65	2.6	3.5	3.3
24	2.9	2.65	2.1	2.2	2.7	4.35	3.6	2.5	5.05	2.6	3.4	3.3
25	2.9	2.6	2.1	2.15	2.7	4.2	3.4	2.5	5.0	2.6	3.3	3.25
26	2.9	2.6	2.1	2.1	2.8	4.1	3.55	2.4	4.6	3.35	3.2	3.2
27	2.9	2.6	2.1	2.5	2.85	4.1	3.65	2.4	4.4	3.2	3.25	3.2
28	2.85	2.5	2.1	2.8	2.9	4.1	3.3	3.65	4.4	3.35	3.5	3.1
29	2.8	.....	2.25	3.15	2.9	4.1	3.5	3.45	4.4	3.6	3.4	3.1
30	2.8	.....	2.1	3.3	2.9	4.1	3.55	3.3	4.3	3.85	3.4	3.1
31	3.2	.....	2.1	.....	2.9	.....	3.5	3.25	.....	3.5	.....	3.1
1908.												
1	3.1	2.4	2.1	1.7	2.5	2.2	1.6	3.7	4.65	2.3	1.5	1.5
2	3.1	2.35	2.1	1.7	2.65	2.2	1.55	3.5	4.6	2.3	1.5	1.5
3	3.0	2.3	2.1	1.75	2.7	2.35	1.5	3.05	6.05	2.25	1.5	1.5
4	3.0	2.3	2.1	1.85	2.6	2.3	1.5	3.05	6.55	2.1	1.5	1.5
5	3.0	2.3	2.1	1.9	2.55	2.3	1.5	5.6	6.9	2.1	1.5	1.5
6	2.95	2.3	2.1	1.85	2.45	2.7	1.35	6.7	6.7	2.05	1.5	1.5
7	2.9	2.3	2.0	1.8	2.4	2.6	1.2	5.45	6.85	2.2	1.5	1.5
8	2.85	2.3	2.0	1.8	2.4	2.5	4.9	5.8	6.9	2.55	1.5	1.5
9	2.8	2.45	1.9	1.8	2.3	2.5	3.25	4.95	6.2	2.45	1.5	1.5
10	2.8	2.4	1.9	1.85	2.3	2.45	3.35	4.55	5.4	2.4	1.5	1.5
11	2.8	2.4	1.9	1.85	2.3	2.25	3.2	4.1	4.9	2.15	1.5	1.5
12	2.75	2.4	1.9	2.6	2.3	2.2	2.1	3.4	4.8	1.95	1.5	1.5
13	2.7	2.35	1.85	2.4	2.2	2.2	2.25	5.7	5.7	1.85	1.5	1.5
14	2.7	2.3	1.8	2.1	2.15	2.2	2.0	7.2	5.5	1.8	1.5	1.4
15	2.65	2.3	1.8	2.05	2.0	2.2	1.8	7.85	5.25	1.8	1.5	1.4
16	2.6	2.3	1.8	2.0	2.0	2.1	1.7	7.45	4.8	1.7	1.5	1.4
17	2.6	2.25	1.8	2.0	2.15	1.95	1.8	7.15	4.35	1.65	1.5	1.4
18	2.6	2.2	1.7	2.2	2.3	1.75	1.75	5.3	4.0	1.6	1.5	1.4
19	2.55	2.2	1.7	4.45	2.25	1.7	1.65	4.5	3.75	1.6	1.5	1.4
20	2.5	2.2	1.7	4.4	2.2	1.7	1.6	4.25	3.5	1.6	1.5	1.4
21	2.5	2.2	1.7	3.45	2.2	1.7	1.6	4.3	3.35	1.6	1.5	1.4
22	2.5	2.2	1.7	2.7	2.1	1.65	1.6	4.2	3.2	1.6	1.5	1.4
23	2.5	2.25	1.7	2.15	4.45	1.55	3.2	4.2	3.0	1.6	1.5	1.4
24	2.5	2.15	1.7	2.1	8.9	1.5	2.05	4.1	2.85	1.6	1.5	1.4
25	2.5	2.1	1.7	2.1	4.9	3.8	1.65	3.9	2.6	1.6	1.5	1.4
26	2.5	2.1	1.7	2.1	3.55	2.5	4.1	4.2	2.55	1.6	1.5	1.4
27	2.5	2.1	1.7	2.05	2.85	2.15	3.75	4.65	2.5	1.6	1.5	1.4
28	2.5	2.1	1.7	2.0	2.6	1.85	2.95	4.2	2.4	1.6	1.5	1.4
29	2.5	2.1	1.8	2.0	2.35	1.75	2.65	4.1	2.3	1.6	1.5	1.4
30	2.5	.....	1.7	2.0	2.3	1.65	3.5	4.7	2.3	1.6	1.5	1.4
31	2.5	.....	1.7	.....	2.25	.....	3.95	4.25	.....	1.55	.....	1.4

Daily discharge, in second-feet, of Rio Grande at Eagle Pass, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4,980	4,600	3,760	2,640	5,580	5,080	8,600	7,060	5,530	9,210	5,840	6,640
2	4,980	4,580	3,440	2,640	5,600	5,240	8,760	7,150	5,790	7,910	5,530	5,910
3	a4,980	a4,560	a3, 30	a2,560	a 5,510	a 5,490	a9,720	a 7,250	a 9,140	a 7,910	a 6,970	a 11,760
4	4,640	4,560	3,050	2,550	5,270	5,550	9,430	6,280	11,870	7,910	7,090	22,560
5	4,510	4,560	3,050	2,540	5,040	5,700	9,530	5,920	10,190	11,350	7,220	a 13,500
6	a4,370	a4,620	3,050	a2,530	a 4,800	a 5,700	a9,630	a 5,660	a12,060	a10,050	7,940	12,950
7	4,330	4,450	a3,050	3,110	4,660	5,400	8,490	5,610	12,640	6,820	a 8,070	12,640
8	4,280	4,280	3,140	3,170	5,000	6,600	8,040	5,670	12,250	6,380	8,070	a 12,390
9	4,240	a4,120	3,350	3,230	4,730	a 7,090	7,350	a 5,520	a13,130	5,950	a22,270	11,180
10	a4,190	4,250	a3,450	3,230	a 4,710	7,670	a7,190	5,240	14,340	a 4,730	28,260	9,800
11	4,230	4,110	3,320	3,230	4,640	8,070	7,030	5,170	16,050	4,220	17,570	8,760
12	4,270	a3,790	3,380	a3,160	4,570	a 8,270	7,360	a 4,880	a16,230	4,460	a12,440	a 8,250
13	a4,310	3,840	a3,430	3,040	a 4,370	8,760	a8,080	4,900	13,870	a 4,700	11,100	8,410
14	4,300	3,890	3,400	3,040	4,290	7,850	9,680	5,010	11,730	4,550	10,130	8,420
15	4,290	a3,760	3,310	a2,920	4,450	a 6,940	8,550	a 4,920	a11,300	4,390	a 9,400	a 8,430
16	a4,280	3,760	a3,220	2,950	a 4,620	6,660	a7,220	4,900	10,940	a 4,080	9,900	8,110
17	4,280	3,920	3,170	2,870	4,620	7,110	7,400	4,980	9,540	4,040	9,810	7,940
18	4,790	a3,760	3,010	a2,660	4,620	a 7,840	7,990	a 4,800	a10,240	4,000	a 9,950	a 7,620
19	a4,790	3,830	a2,970	2,570	a 4,310	10,310	a8,370	4,740	8,980	3,960	8,600	6,910
20	4,570	3,910	2,900	2,610	4,750	8,710	8,170	4,390	8,780	3,920	7,490	6,400
21	4,570	a3,910	2,840	a2,580	4,750	a 8,710	7,660	a 4,290	a16,980	3,880	a 6,620	a 5,690
22	a4,570	3,870	a2,840	2,630	a 4,230	10,000	a7,400	4,180	16,030	3,700	6,620	5,850
23	4,530	3,830	2,830	2,670	3,960	10,900	7,120	4,180	15,280	3,430	6,460	5,810
24	4,480	3,720	2,820	a2,720	3,900	a 9,990	7,180	a 4,180	a13,000	3,310	a 6,310	a 5,970
25	a4,440	a3,620	a2,870	2,660	a 3,840	9,160	a6,370	4,150	12,740	3,190	6,130	5,760
26	4,440	3,640	2,800	2,600	4,320	8,510	6,770	3,910	10,660	5,720	5,960	5,570
27	4,430	3,670	2,720	a3,600	4,680	a 8,290	7,000	a 3,880	a 9,620	5,220	a 6,110	a 5,450
28	a4,320	a3,560	a2,640	4,330	a 5,050	8,210	a5,640	6,630	9,620	5,720	6,870	5,130
29	4,220	.....	2,820	5,180	5,060	8,130	6,520	6,000	9,620	6,470	6,560	5,000
30	4,220	.....	2,640	5,550	5,070	a 8,040	6,870	5,530	a 9,210	7,220	a 6,560	4,880
31	a5,020	.....	a2,640	.....	5,080	.....	a6,870	a 5,430	.....	5,840	.....	a 4,750
1908.												
1	4,820	3,140	2,730	2,120	3,590	4,130	2,650	7,390	10,100	3,380	2,240	2,260
2	4,880	3,100	2,740	2,120	3,610	4,000	2,700	6,550	9,860	3,380	2,240	2,240
3	a4,750	a3,070	a2,750	a2,160	a 3,440	a 4,050	a2,740	a 4,620	a17,020	a 3,330	a 2,240	a 2,230
4	4,690	2,940	2,710	2,230	3,320	3,850	2,740	4,620	20,540	3,090	2,240	2,220
5	4,630	2,820	2,660	2,270	3,300	3,710	2,740	13,340	23,200	3,090	2,230	2,210
6	a4,470	a2,690	a2,620	2,230	a 3,180	a 4,210	a2,510	a17,100	a21,680	a 2,970	a 2,230	a 2,200
7	4,370	2,890	2,590	a2,190	3,260	4,110	2,420	12,290	22,840	3,330	2,230	2,180
8	4,320	3,090	2,590	2,230	3,440	4,010	10,800	13,640	23,230	4,160	2,230	2,170
9	a4,270	a3,620	2,570	2,260	a 3,420	a 4,120	a4,670	10,370	a18,180	a 3,930	a 2,230	a 2,160
10	4,350	3,510	a2,570	a2,400	3,530	3,930	4,870	a 8,830	13,950	3,870	2,250	2,160
11	4,430	3,510	2,550	2,400	3,650	3,170	4,570	7,750	11,310	3,590	2,270	2,160
12	a4,420	a3,510	2,530	3,970	3,760	a 2,970	a2,350	6,200	a10,780	3,370	a 2,280	a 2,150
13	4,290	3,360	a2,460	a3,550	a 3,670	2,890	2,650	a15,660	15,470	a 3,250	2,280	2,200
14	4,260	3,210	2,400	3,010	3,610	2,800	2,390	24,690	14,430	3,110	2,270	2,150
15	a4,120	a3,150	2,390	2,920	3,430	a 2,720	2,180	28,600	a13,190	3,030	a 2,270	2,200
16	3,960	3,100	2,390	a2,840	a 3,430	2,660	a2,080	a26,200	11,410	a 2,830	2,260	2,220
17	3,900	2,950	2,380	2,840	3,330	2,570	2,150	24,640	9,640	2,750	2,260	2,230
18	a3,840	a2,800	2,280	3,240	3,220	a 2,460	2,100	15,400	a 8,260	2,680	a 2,260	a 2,250
19	3,730	2,810	2,270	9,700	a 2,880	2,460	a1,950	a11,280	7,220	a 2,650	2,280	2,220
20	3,620	2,820	2,270	9,510	2,850	2,490	1,850	9,670	6,170	2,680	2,300	2,200
21	3,620	a2,840	a2,260	6,060	2,870	a 2,520	1,850	10,000	a 5,550	2,710	a 2,320	a 2,180
22	a3,620	2,900	2,250	a3,660	a2,780	2,420	a1,850	a 9,100	5,180	a 2,740	2,320	2,190
23	3,660	3,060	2,240	3,310	12,180	2,210	5,060	9,100	4,840	2,630	2,310	2,200
24	3,710	a2,910	a2,230	3,270	a49,560	a 2,110	2,810	8,580	a 4,580	2,520	a 2,310	a 2,210
25	a3,760	2,790	2,210	a3,270	a12,630	7,060	a2,020	a 7,560	4,220	a 2,410	2,310	2,210
26	3,730	2,790	2,190	3,270	6,190	4,260	7,840	9,060	4,140	2,410	2,300	2,210
27	3,700	a2,790	a2,170	3,190	4,120	a 3,510	6,830	11,310	a 4,070	2,420	a 2,290	a 2,210
28	a3,660	2,750	2,160	a3,110	a 3,420	2,930	a4,560	a 8,500	3,770	a 2,420	2,290	2,200
29	3,530	a2,710	2,250	2,990	3,440	2,740	3,960	8,000	3,470	2,380	2,280	2,190
30	3,410	.....	2,130	a2,870	3,850	a 2,540	6,950	11,000	a 3,380	2,350	a 2,280	2,180
31	a3,280	.....	a2,120	.....	a 4,270	.....	a8,540	a 8,020	.....	a 2,260	.....	a 2,170

a Dates of measurement.

Monthly discharge of Rio Grande at Eagle Pass, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	5,020	4,190	4,479	275,405
February	4,620	3,560	4,035	224,073
March	3,760	2,640	3,066	188,509
April	5,550	2,530	3,053	181,646
May	5,600	3,840	4,712	289,745
June	10,900	5,080	7,666	456,158
July	9,720	5,640	7,806	479,980
August	7,250	3,880	5,239	322,135
September	16,980	5,530	11,579	688,978
October	11,350	3,190	5,621	345,600
November	28,260	5,530	9,262	551,107
December	22,560	4,750	8,337	512,608
The year	28,260	2,530	6,238	4,515,944
1908.				
January	4,880	3,280	4,058	249,521
February	3,620	2,690	3,022	173,811
March	2,750	2,120	2,408	148,086
April	9,700	2,120	3,373	200,707
May	49,560	2,780	5,588	343,596
June	4,210	2,110	3,320	197,573
July	10,800	1,850	3,722	228,853
August	28,600	4,620	11,905	732,040
September	23,230	3,380	11,056	657,877
October	4,160	2,260	2,959	181,924
November	2,320	2,230	2,270	135,074
December	2,260	2,150	2,199	135,193
The year	49,560	1,850	4,657	3,384,255

RIO GRANDE NEAR NUEVO LAREDO, TAMAULIPAS, MEXICO, AND LAREDO, TEX.

The station was established near Nuevo Laredo, Mexico, in April, 1900, by the International Boundary Commission. It was intended to measure the river from the highway bridge connecting Laredo with Nuevo Laredo, Tamaulipas, and the gage was established on the right bank just above the bridge. Measurements were kept up by the Mexican section of the commission until September 24, 1900, and gage heights were read until February 28, 1903, but the results were so conflicting that the station was abandoned. In July, 1903, a cable station was established by the commission about 2 miles above Nuevo Laredo, and on August 1, 1903, regular meter measurements and gage heights were started. The new gage heights are not comparable with the old. This station is about 670 miles below El Paso.

The river bed at the new station is constantly shifting, and frequent discharge measurements are made to determine closely the daily discharge. The banks at the new station are not subject to overflow.

The observations at these stations have been made under the direction of the Mexican section of the International Boundary Commission.

Discharge measurements and gage heights for the years 1900 to 1904, which have not hitherto been published by the United States Geological Survey, are given herewith, together with those for 1907–8.

Discharge measurements of Rio Grande near Nuevo Laredo, Tamaulipas, Mexico, in 1900.

[By E. Zayas and Luis Varela.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	2,352	0.8	5,253	July 24	2,653	1.5	6,178
May 8	2,223	.7	4,951	July 26	3,025	2.2	9,256
May 9	2,388	1.2	6,437	July 28	2,713	1.6	7,129
May 15	11,652	12.0	75,141	July 30	3,216	2.5	9,728
May 23	2,901	3.0	13,377	August 3	3,670	3.0	133,283
May 28	2,452	2.2	9,710	August 7	4,083	3.7	16,279
May 31	2,581	1.5	6,483	August 10	7,170	6.85	46,528
June 1	6,137	8.0	31,544	August 13	4,727	4.0	17,533
June 7	2,793	1.7	9,161	August 16	3,463	3.1	11,688
June 9	2,470	1.6	7,311	August 20	3,327	2.35	9,236
June 11	2,379	1.5	5,852	August 22	3,984	3.3	15,059
June 15	2,564	1.3	6,333	August 25	3,580	2.5	12,069
June 20	2,621	1.6	7,134	August 31	3,099	2.05	8,858
June 22	2,459	1.3	6,445	September 3	3,486	2.1	10,669
June 25	2,436	1.2	5,576	September 6	3,157	2.0	10,254
July 2	2,707	2.1	8,142	September 7	4,047	3.8	[a] 17,872
July 6	2,407	1.4	6,672	September 12	2,451	1.25	6,079
July 9	2,576	1.5	6,950	September 15	3,115	1.9	9,174
July 14	2,334	0.8	4,719	September 18	2,974	2.0	8,626
July 16	3,640	3.5	18,607	September 21	2,801	1.6	7,248
July 20	3,152	2.6	10,039	September 24	7,283	8.55	48,715

[a] Observation made on September 7 and 8, 1900.

Discharge measurements of Rio Grande near Laredo, Tex., in 1903.

[By Luis Varela.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 1	2,173	3.55	6,303	October 22	2,059	2.5	4,292
August 5	1,659	2.60	3,680	October 26	1,805	2.45	3,322
August 11	1,654	2.30	3,270	October 30	1,753	2.4	3,084
August 15	1,647	2.30	2,965	November 4	1,653	2.1	2,721
August 20	1,588	2.20	2,625	November 7	1,629	2.0	2,556
August 25	1,885	3.10	4,755	November 10	1,421	2.0	2,441
August 30	1,791	2.90	4,446	November 17	1,454	2.0	2,594
September 4	1,854	3.0	4,665	November 21	1,426	1.9	2,360
September 8	2,216	3.8	7,476	November 24	1,421	1.9	2,365
September 10	7,485	12.55	[a] 34,291	November 28	1,452	1.9	2,461
September 12	5,875	9.45	50,702	December 1	1,408	1.9	2,303
September 18	2,310	3.7	7,817	December 5	1,363	1.8	2,193
September 22	2,085	2.8	5,631	December 10	1,452	1.8	2,357
September 29	2,171	3.9	7,529	December 19	1,320	1.7	1,844
October 3	2,518	4.2	9,966	December 23	1,327	1.7	1,885
October 9	2,256	3.8	8,053	December 26	1,323	1.7	2,092
October 14	2,249	2.9	5,255	December 29	1,351	1.7	2,067
October 19	2,209	2.6	5,096				

[a] Extreme high water September 10, 1903, due to backwater from floods in streams below Laredo.

Discharge measurements of Rio Grande near Laredo, Tex., in 1904.

[By Luis Varela.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	1,323	1.7	2,208	June 23	1,433	2.00	2,507
January 10	1,353	1.7	2,317	June 28	1,513	2.10	2,663
January 14	1,301	1.6	2,213	June 30	3,786	8.10	21,047
January 18	1,330	1.6	2,170	July 5	2,124	2.5	4,067
January 23	1,357	1.6	2,332	July 9	1,840	1.9	2,746
January 27	1,370	1.5	2,316	July 12	1,837	1.8	2,611
January 31	1,355	1.5	2,260	July 18	1,707	1.3	2,389
February 3	1,351	1.5	2,216	July 23	1,600	1.2	1,981
February 8	1,369	1.5	2,277	July 26	2,550	3.9	7,944
February 13	1,372	1.55	2,305	July 31	1,374	1.6	2,448
February 17	1,364	1.45	2,281	August 5	1,158	1.4	1,840
February 21	1,390	1.5	2,309	August 9	1,297	1.4	2,216
February 25	1,403	1.5	2,345	August 13	1,196	1.5	1,948
February 29	1,406	1.5	2,360	August 20	1,077	1.2	1,500
March 1	1,385	1.5	2,374	August 24	1,130	1.1	1,592
March 5	1,378	1.5	2,340	August 27	1,056	1.2	1,448
March 8	1,365	1.5	2,325	August 31	1,196	1.4	1,857
March 14	1,299	1.3	2,166	September 3	1,429	1.9	2,718
March 19	1,291	1.3	2,147	September 9	3,135	6.5	19,098
March 23	1,271	1.3	2,077	September 13	8,040	17.7	48,235
March 28	1,277	1.3	2,069	September 27	4,277	6.5	18,548
April 3	2,748	4.0	9,780	September 30	3,750	5.8	15,598
April 5	2,206	2.55	5,146	October 4	2,979	4.8	11,860
April 12	1,336	1.3	2,304	October 8	2,991	4.0	8,454
April 16	1,321	1.3	2,269	October 12	2,992	4.2	8,779
April 21	1,310	1.3	2,230	October 19	4,709	8.5	28,841
April 23	1,318	1.3	2,242	October 27	4,470	7.0	21,438
April 26	1,444	1.6	2,674	October 31	3,422	5.2	14,236
May 1	1,291	1.6	2,203	November 3	3,512	5.8	12,750
May 5	1,270	1.55	2,145	November 7	2,957	4.6	8,384
May 10	1,258	1.5	2,116	November 11	2,884	4.3	7,368
May 19	1,262	1.4	1,859	November 19	2,427	3.2	6,460
May 22	1,051	1.0	1,225	November 25	2,455	2.7	5,437
May 24	1,046	1.0	1,274	November 29	2,275	2.6	5,051
May 28	1,359	1.9	2,444	December 6	2,197	2.4	4,838
May 31	2,346	4.2	8,298	December 9	2,386	3.4	6,715
June 4	1,490	2.30	3,033	December 14	2,675	3.1	6,093
June 8	1,559	2.40	3,329	December 20	2,332	3.1	6,144
June 14	1,733	3.50	6,106	December 23	2,271	2.9	5,162
June 20	1,449	1.90	2,456	December 30	2,189	2.4	4,216

Discharge measurements of Rio Grande near Laredo, Tex., in 1907.

[By Luis Varela.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq.-ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	1,839	3.9	4,388	July 8	2,526	5.85	11,952
January 10	2,046	3.9	4,929	July 15	2,357	5.05	8,791
January 14	2,016	3.8	4,862	July 20	2,058	4.7	7,270
January 18	2,033	3.8	4,835	July 25	2,013	4.4	6,481
January 23	2,038	3.8	5,102	July 30	1,973	4.2	5,698
January 28	1,891	3.8	4,647	August 5	1,998	4.4	6,305
February 1	1,887	3.8	4,814	August 10	1,975	4.4	6,165
February 8	2,063	4.0	4,638	August 18	1,864	4.0	4,890
February 11	1,855	3.7	4,325	August 22	1,798	3.7	3,815
February 16	1,628	3.6	3,770	August 28	1,475	3.4	3,159
February 21	1,641	3.6	3,808	August 30	1,967	4.5	6,554
February 26	1,577	3.6	3,816	September 5	2,677	5.8	11,506
March 4	1,633	3.4	3,246	September 8	2,575	6.1	12,239
March 9	1,608	3.3	3,238	September 11	2,827	6.55	15,528
March 13	1,613	3.3	3,410	September 13	3,353	7.25	17,317
March 19	1,562	3.3	3,226	September 19	2,435	5.5	10,545
March 23	1,463	3.1	2,877	September 22	3,392	7.65	18,577
March 28	1,371	3.0	2,672	September 30	2,347	5.4	9,452
April 3	1,366	3.0	2,674	October 5	1,994	4.65	6,808
April 9	1,479	3.2	3,202	October 8	1,993	4.8	7,010
April 13	1,547	3.3	3,274	October 14	1,966	4.0	4,496
April 22	1,449	3.1	2,870	October 19	1,783	4.0	4,216
April 25	1,467	3.0	2,848	October 25	1,871	4.0	4,177
April 29	1,615	3.45	3,570	October 30	2,121	4.7	7,648
May 1	2,040	4.25	5,642	October 31	2,375	5.1	8,269
May 7	2,416	4.3	5,557	November 6	2,570	5.0	7,823
May 11	2,495	4.1	5,051	November 10	3,527	7.85	14,267
May 17	2,484	3.9	4,801	November 11	4,193	9.7	20,511
May 22	2,458	4.1	5,426	November 18	2,263	5.0	8,730
May 27	2,458	4.4	5,739	November 25	2,032	4.4	6,636
June 8	2,068	4.3	6,114	November 29	2,213	4.4	6,889
June 12	2,218	4.8	8,001	December 5	3,604	8.0	18,181
June 15	2,180	4.8	8,189	December 10	2,635	5.6	10,675
June 19	2,193	4.95	8,518	December 15	2,553	5.2	9,194
June 20	2,476	5.45	11,795	December 21	2,447	4.5	7,044
June 25	2,442	5.3	10,320	December 27	2,239	4.3	6,086
June 29	2,301	5.0	8,950	December 31	2,277	4.2	5,557
July 4	2,480	5.6	10,814				

Discharge measurements of Rio Grande near Laredo, Tex., in 1908.

[By Luis Varela.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	2,332	4.0	5,123	July 9	3,381	8.5	27,439
January 13	2,018	3.9	4,056	July 14	1,638	3.5	3,902
January 18	1,985	3.8	4,309	July 19	1,316	2.6	2,354
January 21	1,964	3.7	4,180	July 24	1,274	2.4	2,219
January 25	1,893	3.8	5,092	July 28	2,404	5.4	9,127
January 31	1,734	3.2	3,431	July 31	2,219	4.5	6,110
February 5	1,713	3.3	3,478	August 1	2,639	6.3	11,556
February 10	1,628	3.2	3,282	August 6	3,169	7.55	14,561
February 15	1,606	3.1	2,980	August 6	4,687	10.7	37,745
February 20	1,592	3.1	3,030	August 11	2,723	5.8	10,971
February 25	1,566	3.0	2,819	August 15	3,643	8.7	26,127
February 29	1,606	3.0	2,872	August 16	4,658	10.4	32,261
March 5	1,627	3.1	2,960	August 23	2,177	5.0	8,052
March 10	1,666	3.1	3,087	August 30	2,451	5.5	8,789
March 15	1,505	2.9	2,665	September 4	3,493	8.2	22,491
March 20	1,502	2.9	2,578	September 10	3,393	7.7	20,511
March 25	1,369	2.7	2,215	September 15	2,869	6.2	14,007
March 31	1,311	2.6	2,065	September 21	1,905	4.4	6,853
April 5	1,275	2.6	2,060	September 26	2,085	4.0	4,711
April 11	1,390	2.8	2,254	September 30	1,830	3.8	3,986
April 13	2,271	5.5	9,119	October 5	1,878	3.6	3,330
April 16	2,848	7.3	17,356	October 11	1,958	3.9	4,310
April 19	1,674	3.5	3,611	October 15	1,607	3.2	3,023
April 21	4,620	11.0	34,536	October 20	1,570	3.3	3,112
April 25	2,092	3.5	4,402	October 25	1,523	2.9	2,769
April 30	1,881	3.0	3,082	October 31	1,447	2.7	2,440
May 6	1,693	3.5	3,478	November 5	1,440	2.5	2,336
May 11	1,567	3.3	3,161	November 11	1,425	2.3	2,196
May 15	2,025	5.0	6,762	November 15	1,451	2.5	2,384
May 20	1,359	3.3	2,872	November 20	1,390	2.1	2,040
May 26	2,702	6.25	12,206	November 25	1,397	2.3	2,170
May 30	1,847	3.9	4,302	November 30	1,424	2.6	2,311
June 5	1,712	3.5	3,817	December 5	1,418	2.5	2,330
June 11	1,560	3.2	3,222	December 11	1,363	2.5	2,342
June 16	1,470	2.9	2,639	December 15	1,492	2.7	2,636
June 20	1,334	2.7	2,334	December 21	1,592	2.9	3,010
June 25	1,334	2.5	2,263	December 26	1,487	2.6	2,466
June 29	1,452	3.0	2,952	December 31	1,411	2.4	2,272
July 4	1,275	2.3	2,130				

Daily gage height, in feet, of Rio Grande near Nuevo Laredo, Tamaulipas, Mexico, for 1900, 1901, and 1902.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900. [a]												
1					3.35	6.75	3.4	2.9	1.85	3.2	1.5	
2					1.9	3.3	1.8	2.75	2.7	2.75	1.5	
3					1.4	2.0	1.25	3.0	2.1	2.35	1.6	
4					1.1	2.05	1.25	2.85	1.8	2.6	1.55	
5					1.05	2.4	1.3	3.3	1.85	2.5	1.35	
6					1.0	1.85	1.45	3.25	2.0	2.3	1.3	
7					.85	1.65	1.85	3.7	3.8	2.2	2.2	
8					.7	1.7	2.1	3.45	3.1	2.2	1.25	
9					1.15	1.65	1.5	3.9	2.2	2.3	1.3	
10					.85	1.5	1.5	6.85	1.65	2.05	1.2	
11					.8	1.5	1.25	4.85	1.45	2.0	1.2	
12					1.1	1.4	.95	4.55	1.25	1.9	1.1	
13					1.0	1.3	.8	4.0	1.4	1.8	1.1	
14					1.05	1.3	1.2	3.65	1.55	1.75	1.0	
15					8.7	1.35	2.6	3.4	1.9	1.7	1.0	
16					9.15	1.6	3.5	3.1	2.1	1.6	1.1	
17					3.9	1.45	3.3	2.85	2.1	1.5	1.1	
18					2.55	1.65	2.9	2.6	2.0	1.8	1.1	
19					2.0	1.95	3.35	2.5	1.9	1.8	1.1	
20					2.75	1.6	2.6	2.35	1.75	2.05	1.1	
21					2.4	1.4	2.0	2.35	1.6	2.0	1.15	
22					2.1	1.3	1.75	3.3	1.7	2.1	1.0	
23					2.75	1.3	1.55	2.65	8.1	2.05	1.0	
24					3.75	1.1	1.5	2.7	8.55	2.05	1.0	
25					2.85	1.2	1.8	2.5	9.95	2.15	1.0	

[a] Gage heights for 1900 complete so far as Mexican records exist.

Daily gage height, in feet, of Rio Grande near Nuevo Laredo, Tamaulipas, Mexico, for 1900, 1901, and 1902—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.												
26	.....	.....	.....	.....	2.35	1.3	2.15	2.05	5.35	2.2	1.0	.....
27	.....	.....	.....	.....	2.25	1.15	1.65	1.8	3.5	2.1	.9	.....
28	.....	.....	.....	.....	2.0	1.05	1.95	1.8	3.0	2.15	.9	.....
29	.....	.....	.....	.....	1.9	.95	2.6	2.25	2.7	2.7	.9	.....
30	.....	.....	.....	.....	1.5	2.85	2.5	2.1	2.3	1.9	.9	.....
31	.....	.....	.....	.....	1.5	.....	2.7	2.05	.....	1.95	.....	.....
1901.												
1	.....	0.4	0.3	0.25	5.6	2.4	.4	.4	.9	2.5	2.4	3.2
2	.....	.4	.3	.25	3.5	2.4	.4	.4	.9	2.5	2.4	3.2
3	.....	.4	.3	.25	3.0	1.9	.4	.4	.9	2.6	2.4	3.2
4	.....	.4	.3	.25	3.0	1.8	.4	.4	.9	2.7	2.4	3.2
5	.....	.4	.3	.25	2.5	1.6	.4	.4	2.0	2.8	2.4	3.2
6	.....	.4	.3	.25	2.5	1.5	.4	.5	2.0	2.2	2.4	3.2
7	.....	.4	.3	.25	2.5	1.5	.4	.6	3.0	2.2	2.4	3.2
8	.....	.4	.3	.25	2.5	1.4	.4	.7	4.0	2.2	2.4	3.2
9	.....	.4	.3	.25	4.5	1.4	.4	.7	4.5	2.1	2.3	3.2
10	.....	.4	.3	.25	3.0	1.4	.4	.9	5.5	2.1	2.3	3.2
11	.....	.4	.3	.25	3.0	1.3	.4	.9	3.5	2.1	2.2	3.2
12	.....	.4	.3	.25	2.5	1.3	.4	.7	3.0	2.0	2.2	3.2
13	.....	.4	.3	.25	2.5	1.2	.4	.5	3.0	2.0	2.2	3.2
14	.....	.4	.3	.25	2.5	1.2	.4	.4	2.0	2.0	2.2	3.2
15	.....	.4	.3	.25	2.5	1.2	.4	.4	2.8	2.0	2.2	2.3
16	.....	.3	.3	.25	2.5	1.2	.4	.5	2.8	2.6	2.2	2.3
17	.....	.3	.3	.25	2.5	1.0	.4	.6	2.3	2.6	2.2	2.3
18	.....	.3	.3	.25	3.5	1.0	.4	.7	2.6	2.6	2.2	2.3
19	.....	.3	.3	.25	3.0	1.0	.4	.8	2.6	2.5	4.0	2.3
20	.....	.3	.3	.25	2.5	1.0	.4	.8	2.5	2.5	4.0	2.2
21	.....	.3	.3	.25	2.5	1.0	.4	.8	2.3	2.4	4.0	2.2
22	.....	.3	.3	.25	2.5	1.0	.4	.8	2.2	2.4	4.0	2.2
23	.....	.3	.3	.25	2.5	.9	.4	.8	2.2	2.4	4.0	2.2
24	.....	.3	.3	.25	3.2	.9	.4	.8	2.1	2.4	4.0	2.2
25	.....	.3	.3	.25	2.9	.9	.4	.9	2.1	2.4	4.0	2.2
26	.....	.3	.3	.25	2.5	.8	.4	.9	2.0	2.4	4.0	2.2
27	.....	.3	.3	.25	2.5	.8	.4	.9	2.15	2.4	3.6	2.2
28	.....	.3	.3	.25	2.5	.7	.4	.9	2.4	2.4	3.6	2.2
29	.....	.....	.3	.25	2.5	.7	.4	.9	2.4	2.4	3.5	2.2
30	.....	.....	.2	.25	2.5	.5	.4	.9	2.4	2.4	3.4	2.2
31	.....	.....	.....	.....	2.8	.....	.4	.9	.....	2.4	.....	2.3
1902.												
1	2.3	2.3	1.2	.4	.4	.6	.6	3.3	1.95	1.7	.25	.5
2	2.3	2.3	1.2	.4	.4	.9	.5	3.05	2.85	1.2	.35	3.95
3	2.2	2.3	1.2	.4	.4	1.0	1.45	2.65	4.05	1.3	1.0	2.8
4	2.2	2.2	1.1	.4	.4	.9	1.8	2.25	3.9	1.05	1.1	1.0
5	2.2	2.2	1.1	.4	1.8	.8	.95	2.1	3.3	1.8	.8	.5
6	2.2	2.2	1.1	.4	3.65	.7	.75	2.0	3.75	1.45	.6	.3
7	2.2	2.1	1.0	.4	2.6	.65	.6	1.7	3.65	1.0	.5	.3
8	2.2	2.1	1.0	.4	1.85	.6	.55	1.2	3.45	1.1	.65	.35
9	2.2	2.1	1.0	.4	1.7	.6	.5	1.1	3.85	.95	.75	.4
10	2.2	2.0	.9	.4	1.3	.6	.5	1.3	4.95	.7	.6	.4
11	2.2	2.0	.9	.4	.95	.5	.6	1.05	6.3	.6	.5	.35
12	2.2	2.0	.8	.4	.85	.5	.7	.9	6.25	.5	.5	.4
13	2.2	1.9	.8	.4	.8	.5	1.0	.8	5.4	.5	.5	.4
14	2.2	1.9	.7	.4	.75	.5	1.4	.7	4.95	.65	.5	.4
15	2.2	1.9	.7	.4	.7	.6	1.65	.6	4.35	1.05	.5	.4
16	2.2	1.7	.6	.4	.6	.7	2.95	2.8	3.65	1.6	.4	.3
17	2.2	1.7	.6	1.35	.6	.8	2.45	2.1	3.15	.95	.7	.3
18	2.2	1.7	.5	1.15	.6	.7	1.95	1.7	2.65	1.2	1.0	.3
19	2.2	1.7	.5	.85	2.35	.65	1.85	1.7	3.05	.4	.8	.3
20	2.2	1.6	.5	.75	4.6	.7	1.85	1.65	3.25	.4	.6	.2
21	2.2	1.6	.5	.7	2.8	.65	1.85	1.5	2.15	.4	.4	.2
22	2.3	1.6	.5	.65	1.65	.6	1.7	1.5	1.8	.4	1.0	.2
23	2.3	1.4	.5	.6	1.25	.85	1.7	1.45	2.25	.4	.8	.3
24	2.3	1.4	.5	.5	1.05	1.0	1.85	1.4	2.3	.4	.5	.3
25	2.3	1.4	.5	.45	1.0	.9	2.2	1.4	1.6	.4	.35	.3
26	2.3	1.3	.5	.4	.9	.75	3.0	1.3	1.3	.4	.2	.3
27	2.3	1.3	.5	.4	.85	.65	5.5	1.6	1.25	.4	.3	.3
28	2.3	1.3	.45	.4	.8	.6	4.7	2.45	1.0	.4	.3	.3
29	2.3	.....	.4	.4	.8	.7	3.7	2.45	.95	.4	.3	.3
30	2.3	.....	.4	.4	.7	.7	3.6	2.0	1.8	.3	.3	.3
31	2.3	.....	.4	.....	.7	.....	3.95	1.7	.....	.3	.....	.3

Daily gage height, in feet, of Rio Grande near Laredo, Tex., for 1903–4 and 1907–8.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1	0.3	0.4	.....	.....	.....	.....	.....	3.75	2.9	2.85	2.4	1.9
2	.2	.4	.....	.....	.....	.....	.....	3.95	2.9	3.7	2.4	1.9
3	.2	.3	.....	.....	.....	.....	.....	3.05	3.2	3.05	2.1	1.8
4	.2	.3	.....	.....	.....	.....	.....	2.65	3.45	3.9	2.1	1.8
5	.2	.4	.....	.....	.....	.....	.....	2.45	3.85	4.15	2.05	1.8
6	.2	.4	.....	.....	.....	.....	.....	2.2	3.8	4.1	2.0	1.8
7	.2	.4	.....	.....	.....	.....	.....	2.4	3.75	3.7	2.0	1.8
8	.2	.4	.....	.....	.....	.....	.....	2.8	3.8	3.55	2.0	1.8
9	.2	.4	.....	.....	.....	.....	.....	2.75	3.5	3.4	2.0	1.8
10	.2	.5	.....	.....	.....	.....	.....	2.35	9.5	2.8	2.0	1.8
11	.2	.45	.....	.....	.....	.....	.....	2.15	6.6	2.85	2.0	1.8
12	.25	.4	.....	.....	.....	.....	.....	2.1	6.95	2.9	2.0	1.8
13	.3	.4	.....	.....	.....	.....	.....	2.3	3.7	2.8	2.0	1.8
14	.4	.5	.....	.....	.....	.....	.....	2.25	2.3	2.8	2.0	1.8
15	.4	.4	.....	.....	.....	.....	.....	2.4	2.3	2.8	2.0	1.8
16	.4	.9	.....	.....	.....	.....	.....	2.5	2.6	2.8	2.0	1.8
17	.1	.9	.....	.....	.....	.....	.....	2.45	2.7	2.8	2.0	1.8
18	.75	.9	.....	.....	.....	.....	.....	2.4	3.6	2.6	1.9	1.8
19	.45	.8	.....	.....	.....	.....	.....	2.45	2.85	2.6	1.9	1.7
20	.45	.8	.....	.....	.....	.....	.....	2.4	2.7	2.55	1.9	1.7
21	.45	.6	.....	.....	.....	.....	.....	2.3	2.6	2.5	1.9	1.7
22	.4	.6	.....	.....	.....	.....	.....	2.2	2.6	2.5	2.0	1.7
23	.4	.6	.....	.....	.....	.....	.....	2.4	2.65	2.5	1.95	1.7
24	.4	.6	.....	.....	.....	.....	.....	2.3	2.75	2.45	1.9	1.7
25	.4	.7	.....	.....	.....	.....	.....	3.15	2.75	2.4	1.9	1.7
26	.4	1.6	.....	.....	.....	.....	.....	3.35	2.6	2.45	1.9	1.7
27	.4	1.75	.....	.....	.....	.....	.....	3.05	3.0	2.5	1.9	1.7
28	.4	.85	.....	.....	.....	.....	.....	2.8	3.1	2.95	1.9	1.7
29	.4	.....	.....	.....	.....	.....	.....	2.55	4.45	2.6	1.9	1.7
30	.4	.....	.....	.....	.....	.....	.....	2.6	3.6	2.4	1.9	1.7
31	.4	.....	.....	.....	.....	.....	.....	3.5	.....	2.4	.....	1.7
1904.												
1	1.7	1.5	1.45	1.3	1.5	3.25	5.3	1.6	1.75	5.1	5.75	2.5
2	1.7	1.5	1.4	4.0	1.5	2.8	4.1	1.55	1.95	5.2	5.95	2.4
3	1.7	1.5	1.4	4.2	1.3	2.35	3.65	1.5	1.9	5.35	5.8	2.4
4	1.7	1.5	1.4	3.3	1.3	2.2	2.85	1.45	1.85	4.9	5.45	2.4
5	1.7	1.5	1.45	2.45	1.35	1.9	2.4	1.4	2.4	4.7	5.05	2.35
6	1.7	1.5	1.5	1.95	1.2	1.9	2.3	1.35	2.35	4.7	4.8	2.4
7	1.7	1.5	1.5	1.55	1.2	2.05	2.15	1.3	2.45	4.3	4.55	2.45
8	1.7	1.5	1.45	1.5	1.2	2.5	2.05	1.3	7.5	4.0	4.55	2.75
9	1.7	1.5	1.3	1.4	1.25	3.55	1.9	1.45	7.15	4.0	4.65	3.5
10	1.7	1.5	1.3	1.35	1.35	3.4	1.8	1.5	8.45	3.9	4.55	3.55
11	1.7	1.85	1.3	1.3	1.2	2.9	1.65	1.55	7.0	4.05	4.25	3.3
12	1.6	1.65	1.3	1.3	1.2	2.35	1.7	1.6	9.8	4.2	4.1	3.1
13	1.6	1.55	1.3	1.3	1.2	3.55	1.65	1.5	15.8	4.4	3.9	3.2
14	1.6	1.5	1.3	1.3	3.95	3.4	1.65	1.6	15.65	5.4	3.65	3.15
15	1.6	1.5	1.3	1.3	2.65	3.0	1.5	1.55	20.75	6.9	3.6	2.95
16	1.6	1.5	1.3	1.3	2.1	2.7	1.35	1.5	24.25	8.95	3.45	2.8
17	1.6	1.45	1.3	1.3	2.4	2.65	1.3	1.4	25.0	8.35	3.05	2.9
18	1.6	1.4	1.3	1.3	1.65	2.35	1.3	1.4	18.25	8.4	2.95	2.9
19	1.6	1.4	1.3	1.3	1.35	2.05	1.3	1.35	8.1	8.35	3.2	2.9
20	1.6	1.45	1.3	1.3	1.2	1.95	1.3	1.2	7.0	8.7	3.15	2.9
21	1.6	1.5	1.3	1.3	1.1	2.45	1.25	1.2	8.5	9.05	3.0	2.95
22	1.6	1.5	1.3	1.3	1.0	2.15	1.2	1.0	9.95	8.35	2.95	2.9
23	1.6	1.5	1.3	1.3	1.0	1.9	1.25	1.0	14.0	8.05	2.8	2.9
24	1.6	1.5	1.3	1.3	.95	2.25	1.4	1.1	12.1	8.05	2.7	2.85
25	1.6	1.5	1.3	1.55	.9	2.65	1.85	1.2	10.5	7.7	2.7	2.75
26	1.6	1.5	1.3	1.5	.9	2.4	3.5	1.3	7.9	7.45	2.75	2.65
27	1.5	1.5	1.3	1.3	2.0	2.2	2.5	1.2	8.0	6.9	2.65	2.5
28	1.5	1.5	1.3	1.35	1.85	2.0	1.9	1.15	7.1	6.4	2.6	2.4
29	1.5	1.5	1.3	1.5	2.25	6.7	1.75	1.2	6.8	6.05	2.6	2.4
30	1.5	.....	1.3	1.75	2.75	8.8	1.55	1.3	5.8	5.55	2.5	2.35
31	1.5	.....	1.3	.....	4.7	.....	1.55	1.4	.....	5.25	.....	2.3

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Daily gage height, in feet, of Rio Grande near Laredo, Tex., for 1903–4 and 1907–8—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.9	3.85	3.5	3.0	4.4	4.0	5.0	4.45	4.2	5.3	4.5	4.4
2	3.9	3.9	3.4	3.0	4.4	4.0	5.05	4.4	4.15	5.15	4.5	4.4
3	3.85	3.9	3.4	3.1	4.4	4.0	5.75	4.4	4.2	4.85	4.25	4.3
4	3.8	3.8	3.45	3.05	4.45	4.25	5.4	4.35	4.8	4.6	4.65	5.65
5	3.8	3.8	3.4	3.0	4.4	4.2	5.25	4.35	5.75	4.55	4.8	7.75
6	3.8	3.9	3.4	3.05	4.35	4.3	5.2	4.2	5.3	5.5	5.0	6.85
7	3.8	4.0	3.45	3.1	4.4	4.0	5.3	4.25	5.85	6.15	5.05	6.35
8	3.8	4.0	3.4	3.2	4.35	4.1	6.0	4.3	6.1	4.7	4.95	6.0
9	3.8	3.95	3.4	3.25	4.25	4.35	5.25	4.35	6.05	4.6	4.9	5.75
10	3.85	3.95	3.3	3.3	4.1	4.45	5.0	4.35	6.75	4.45	8.1	5.6
11	3.85	3.75	3.3	3.3	4.05	4.6	4.95	4.0	6.5	4.25	9.55	5.55
12	3.9	3.7	3.3	3.3	4.2	4.7	5.0	4.0	6.85	4.0	7.2	5.5
13	3.8	3.8	3.3	3.3	4.1	5.0	5.05	4.0	7.2	4.0	6.65	5.5
14	3.8	3.7	3.3	3.2	4.1	5.0	5.1	4.0	6.0	4.0	6.15	5.35
15	3.8	3.6	3.2	3.25	4.0	4.7	5.45	4.05	5.35	4.0	5.6	5.2
16	3.8	3.6	3.3	3.3	4.0	4.65	5.25	4.05	5.3	4.0	5.4	5.05
17	3.8	3.6	3.2	3.25	4.05	5.2	5.2	4.05	5.05	4.0	5.0	4.9
18	3.8	3.6	3.3	3.5	4.0	5.3	5.35	4.0	5.1	4.0	5.0	4.65
19	3.85	3.65	3.2	3.35	4.0	5.05	4.85	4.0	5.5	4.0	5.0	4.6
20	3.85	3.6	3.2	3.25	4.1	5.7	4.8	3.9	5.2	4.0	4.85	4.5
21	3.8	3.65	3.2	3.2	4.1	5.15	4.6	3.8	6.55	4.0	4.45	4.5
22	3.8	3.7	3.1	3.15	4.0	5.25	4.5	3.7	7.6	4.0	4.35	4.5
23	3.8	3.7	3.05	3.1	4.0	5.3	4.4	3.65	7.2	3.95	4.4	4.4
24	3.8	3.7	3.0	3.05	4.0	5.35	4.5	3.6	6.85	3.8	4.4	4.35
25	3.8	3.7	3.0	3.0	3.8	5.35	4.5	3.55	6.15	3.85	4.4	4.3
26	3.75	3.6	3.05	3.0	4.0	5.35	4.55	3.4	5.6	3.9	4.35	4.3
27	3.8	3.6	3.0	3.1	4.2	5.0	4.5	3.35	5.55	4.2	4.35	4.3
28	3.8	3.5	2.95	3.15	4.25	5.0	4.5	3.4	5.35	4.45	4.4	4.3
29	3.8	.....	2.95	3.85	4.05	4.95	4.4	3.9	5.35	4.8	4.4	4.2
30	3.8	.....	3.05	4.7	3.9	5.0	4.5	4.45	5.35	4.75	4.4	4.2
31	3.8	.....	3.1	.....	4.05	.....	4.45	4.3	.....	5.55	.....	4.2
1908.												
1	4.15	3.2	3.05	2.6	3.0	3.7	2.4	6.3	5.5	3.8	2.8	2.6
2	4.1	3.2	3.1	2.6	2.9	3.5	2.4	6.05	5.8	3.9	2.8	2.5
3	4.05	3.2	3.1	2.6	3.2	3.45	2.55	4.95	6.5	3.7	2.75	2.5
4	4.0	3.2	3.1	2.6	3.35	3.35	2.5	3.7	7.65	3.65	2.65	2.5
5	4.0	3.3	3.1	2.6	3.5	3.5	2.2	2.95	8.8	3.6	2.55	2.5
6	4.05	3.2	3.05	2.6	3.5	3.55	2.35	8.75	8.5	3.5	2.5	2.4
7	4.1	3.2	3.05	2.6	3.45	3.6	2.25	8.15	8.45	3.5	2.5	2.35
8	4.1	3.2	3.0	2.6	3.4	3.65	2.4	5.35	8.25	4.0	2.4	2.3
9	4.1	3.2	3.1	2.6	3.35	3.6	7.9	5.5	8.6	3.5	2.4	2.4
10	4.1	3.2	3.1	2.6	3.3	3.4	4.45	5.8	7.5	3.75	2.35	2.5
11	3.95	3.2	3.1	2.9	3.3	3.25	3.75	5.7	5.5	3.8	2.25	2.5
12	3.9	3.2	3.05	5.3	3.3	3.3	3.45	5.15	4.55	3.55	2.25	2.5
13	3.9	3.2	3.0	4.8	3.3	3.2	3.4	4.85	4.35	3.55	2.65	2.5
14	3.8	3.15	2.9	3.95	5.65	3.3	3.5	5.85	5.3	3.4	2.65	2.45
15	3.8	3.1	2.9	3.55	4.85	3.1	3.3	9.3	5.65	3.2	2.5	2.7
16	3.8	3.1	2.9	6.2	3.6	2.9	3.05	10.6	6.25	3.1	2.5	2.7
17	3.8	3.1	2.9	4.6	3.2	2.95	2.95	8.2	5.65	3.0	2.4	2.65
18	3.8	3.1	2.9	3.9	3.2	2.8	2.7	5.45	5.35	3.1	2.35	2.6
19	3.7	3.1	2.9	3.4	3.1	2.7	2.55	5.0	5.0	3.15	2.2	2.6
20	3.7	3.1	2.9	5.25	3.3	2.7	2.45	4.6	4.8	3.3	2.1	2.65
21	3.7	3.1	2.8	10.5	3.2	2.6	2.4	4.6	4.35	3.3	2.15	2.9
22	3.7	3.1	2.8	7.3	3.25	2.55	2.35	4.95	4.3	3.25	2.2	2.8
23	3.7	3.1	2.7	6.75	3.3	2.35	2.35	5.0	4.1	3.55	2.3	2.6
24	3.7	3.0	2.7	4.95	4.05	2.35	2.7	4.9	4.1	3.2	2.3	2.6
25	3.8	3.0	2.7	3.5	10.3	2.5	2.5	5.2	4.0	2.9	2.3	2.5
26	3.7	3.0	2.7	3.15	5.85	2.5	2.35	5.3	4.0	2.85	2.2	2.6
27	3.6	3.0	2.7	3.0	4.65	2.55	3.6	5.4	3.95	2.8	2.35	2.45
28	3.5	3.0	2.65	3.0	4.1	2.75	5.2	5.6	3.8	2.8	2.45	2.45
29	3.4	3.0	2.6	3.0	3.9	2.9	3.7	4.9	3.75	2.75	2.5	2.5
30	3.2	.....	2.6	3.0	3.9	2.6	3.15	5.4	3.8	2.7	2.6	2.45
31	3.2	.....	2.6	.....	3.85	.....	4.25	6.05	.....	2.7	.....	2.4

RIO GRANDE NEAR ROMA, TEX.

The station was established in 1900 by the International Boundary Commission. It is near Roma, Tex., 775 miles by river below El Paso.

The right bank is alluvial deposit and overflows in high water for a width of 250 feet. The overflow section is thickly covered with mesquite brush. The left bank is of hard material and does not overflow.

The river bed is constantly shifting and frequent discharge measurements are necessary to determine closely the daily discharge. The section is subject to overflow at high water.

The highest recorded flood, September 16, 1904, marked 26 feet on the gage.

The observations at this station have been made under the direction of the Mexican section of the International Boundary Commission.

Discharge measurements and gage heights for the years 1900 to 1904, which have not hitherto been published by the United States Geological Survey, are given herewith, together with those for 1907–8.

Discharge measurements of Rio Grande near Roma, Tex., in 1900.

[By S. P. Vale.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 9	3,359	6.45	16,489	November 11	1,813	4.5	5,262
September 13	2,059	4.6	6,661	November 14	1,811	4.4	5,097
September 17	2,645	5.6	8,914	November 17	1,815	4.4	5,101
September 22	2,330	4.95	7,209	November 21	1,829	4.4	5,100
September 26	6,624	12.9	43,626	November 24	1,812	4.4	5,128
September 29	3,055	5.85	12,443	November 28	1,714	4.2	4,532
October 4	2,650	6.2	10,026	December 1	1,680	4.1	3,951
October 8	2,576	5.8	9,168	December 5	1,609	4.1	4,015
October 16	2,493	5.1	7,515	December 8	1,603	4.1	4,032
October 19	2,377	5.0	7,177	December 13	1,699	4.1	3,992
October 24	2,524	5.7	9,744	December 17	1,727	4.1	4,174
October 26	2,484	5.4	8,011	December 21	1,592	4.0	3,895
October 30	2,816	6.3	12,021	December 25	1,531	3.9	3,588
November 3	1,994	4.9	6,554	December 29	1,495	3.9	3,420
November 7	1,936	4.7	6,040				

NOTE.—Discharge measurements for 1900 complete so far as Mexican records exist.

Discharge measurements of Rio Grande near Roma, Tex., in 1901.

[By S. P. Vale.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	1,568	4.0	3,211	July 10	981	2.9	1,828
January 7	1,563	3.9	3,218	July 14	968	2.9	1,556
January 11	1,525	3.9	3,344	July 18	854	2.7	1,435
January 15	1,471	3.8	3,280	July 21	846	2.8	1,521
January 19	1,453	3.7	3.011	July 26	1,122	3.3	2,049
January 23	1,460	3.8	3.062	July 30	1,447	4.0	2,779
January 26	1,561	4.0	3,298	August 3	1,579	4.2	3,095
January 30	1,518	3.9	3,131	August 7	1,873	4.6	3,707
February 3	1,503	3.9	2,901	August 11	1,925	4.7	4,048
February 7	1,552	3.9	2,989	August 15	1,766	4.6	3,916
February 11	1,539	3.8	2,886	August 20	1,408	3.9	2,898
February 15	1,480	3.7	2,859	August 25	1,360	4.4	3,691
February 19	1,556	3.7	2,722	August 29	1,552	4.3	3,513
February 23	1,482	3.6	2,600	September 1	1,264	3.5	2,532
February 27	1,380	3.5	2,572	September 7	1,394	3.7	3,576
March 3	1,510	3.8	3,080	September 10	1,128	3.35	2,734
March 8	1,349	3.6	2,620	September 11	2,884	7.6	14,332
March 12	1,314	3.5	2,573	September 16	1,268	4.1	3,225
March 16	1,184	3.4	2,413	September 20	1,546	4.15	4,186
March 20	1,152	3.2	2,150	September 24	1,995	5.25	8,075
March 24	1,052	3.1	2,098	September 28	1,810	4.55	5,575
March 28	1,014	3.0	1,908	October 2	1,412	3.8	3,520
April 10	1,016	2.8	1,974	October 7	1,152	3.6	2,816
April 14	1,127	2.9	2,062	October 11	1,236	3.6	2,919
April 17	1,087	2.8	2,123	October 13	1,946	5.25	7,834
April 20	1,159	2.7	2,011	October 15	1,402	3.8	3,568
April 23	1,078	2.6	1,786	October 20	1,270	3.5	2,441
April 27	1,048	2.6	1,729	October 24	1,326	3.5	2,977
April 29	1,059	2.5	1,761	October 29	1,443	4.0	3,866
May 3	2,599	5.8	11,080	November 4	1,779	4.45	5,392
May 9	1,962	5.35	8,778	November 8	1,490	4.05	4,481
May 14	1,332	3.8	3,348	November 12	1,560	3.9	4,243
May 18	1,191	3.6	2,807	November 17	1,658	4.2	4,602
May 22	1,270	3.6	3,027	November 21	1,602	4.2	4,616
May 26	2,382	6.6	10,206	November 25	1,372	3.7	3,570
May 30	1,422	3.8	3,479	November 29	1,946	5.0	6,564
June 4	1,513	4.2	4,040	December 4	1,441	3.8	3,143
June 8	1,532	4.0	3,734	December 9	1,448	3.7	3,044
June 12	1,554	4.15	3,861	December 13	1,326	3.55	2,732
June 16	1,479	4.0	3,177	December 18	1,242	3.4	2,524
June 20	1,638	4.0	3,010	December 22	1,164	3.35	2,432
June 25	1,204	3.3	2,290	December 26	1,153	3.25	2,427
June 30	2,518	5.9	10,044	December 31	1,149	3.2	2,058
July 4	1,220	3.2	2,275				

Discharge measurements of Rio Grande near Roma, Tex., in 1902.

[By S. P. Vale and A. Argándar.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	1,178	3.1	2,190	July 9	794	2.4	1,408
January 8	1,165	3.1	2,156	July 12	707	2.1	1,231
January 13	1,269	3.4	2,401	July 17	1,817	5.4	[a] 7,113
January 17	1,340	3.5	2,540	July 21	1,344	3.45	3,681
January 22	1,294	3.2	2,218	July 26	1,444	3.85	3,831
January 26	1,292	3.0	2,095	July 29	4,111	10.1	[b] 29,847
January 30	1,260	2.9	1,922	August 4	2,196	5.8	9,511
February 5	1,259	2.9	2,100	August 8	1,811	4.9	6,667
February 9	1,274	3.0	2,139	August 13	1,507	4.0	3,823
February 13	1,292	2.95	2,071	August 16	1,506	4.0	3,198
February 17	1,029	2.9	1,951	Do. [c]	1,504	4.0	3,301
February 21	1,061	2.8	1,820	August 22	2,205	4.7	6,034
February 26	978	2.7	1,888	August 26	2,042	4.8	5,745
March 3	1,098	2.6	1,743	September 3 [c]	2,651	6.2	10,788
March 8	941	2.3	1,565	September 7	2,256	5.4	9,108
March 12	912	2.2	1,509	September 11	3,624	8.75	21,363
March 17	879	2.2	1,460	September 13	4,381	10.1	28,188
March 19	832	2.1	1,370	September 17	2,912	7.0	14,155
March 23	707	2.0	1,304	September 21	3,178	7.5	15,435
March 27	716	2.1	1,385	September 25	2,443	5.8	7,390
March 31	701	1.9	1,324	September 29	1,452	4.2	3,995
April 4	687	1.8	1,308	October 3	2,916	7.75	15,055
April 9	694	1.9	1,339	October 7	1,568	4.4	4,746
April 13	659	1.8	1,243	October 11	1,338	3.6	2,512
April 15	1,758	4.3	[a] 4,932	October 15	2,671	7.0	13,161
April 22	1,265	2.8	1,941	October 16	3,497	9.1	21,161
April 27	913	2.0	1,380	October 21	1,495	4.2	4,394
May 4	733	1.8	1,162	October 26	1,146	3.3	2,666
May 6	3,592	8.4	[a] 19,833	October 30	993	3.1	2,280
May 10	1,350	3.95	4,378	November 4	1,408	3.8	3,943
May 19	801	2.5	1,573	November 12	1,335	3.3	3,679
May 21	3,325	8.5	[a] 21,184	November 16	1,271	2.9	3,379
May 26	854	3.2	2,283	November 20	1,131	2.6	2,700
May 31	785	2.9	1,764	November 24	1,432	3.8	4,125
June 3	675	2.5	1,411	November 28	1,253	3.1	3,379
June 6	890	3.0	1,982	December 4	2,324	5.8	7,135
June 11	671	2.3	1,339	December 9	1,486	4.3	4,431
Do	671	2.3	1,453	December 13	1,208	2.9	2,338
June 16	608	2.0	1,118	December 17	1,212	2.9	2,394
June 20	723	2.5	1,459	December 21	1,129	2.8	2,084
June 25	837	2.8	1,776	December 25	1,107	2.8	1,908
June 29	760	2.4	1,429	December 31	1,019	2.8	1,642
July 5	1,257	4.0	3,717				

[a] Measurements April 15, May 6 and 21, July 17, 1902, made by floats.
[b] Measurement July 29, 1902, made by floats. Maximum gage height 11.5 feet.
[c] Extra measurement on August 16 and measurement on September 3, 1902, made by E. Zayas.

Discharge measurements of Rio Grande near Roma, Tex., in 1903.

[By A. Argándar and H. P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	992	2.7	1,535	August 4	2,309	5.3	10,104
January 9	982	2.7	1,410	August 8	1,335	3.3	4,124
January 17	1,008	3.0	1,619	August 11	1,235	3.4	4,164
January 21	989	2.9	1,499	August 15	1,256	3.2	3,668
January 25	967	2.9	1,476	August 18	1,685	4.3	5,432
January 29	977	2.7	1,426	August 20	1,656	4.0	5,077
January 31	957	2.7	1,446	August 22	1,623	3.5	3,766
February 4	944	2.7	1,450	September 3	2,170	4.2	4,964
February 8	975	2.8	1,519	September 7	2,645	5.6	8,077
February 12	939	2.6	1,370	September 12	3,520	7.55	15,731
February 17	927	2.4	1,231	September 15	1,757	3.8	5,606
February 18	1,424	2.7	3,938	September 21	1,684	3.7	5,304
February 20	1,316	3.2	3,658	September 25	1,763	3.5	4,665
February 24	1,296	3.0	3,508	September 29	2,358	3.9	4,881
February 28	1,282	3.1	3,481	October 7	3,550	5.9	11,151
May 5	1,554	3.2	3,631	October 13	2,667	3.8	6,704
May 8	1,279	2.7	2,569	October 17	2,435	3.6	5,942
May 12	1,363	2.9	3,473	October 20	1,947	2.7	4,189
May 15	2,598	5.5	13,121	October 24	1,778	2.5	3,901
May 20	2,442	5.4	10,750	October 27	1,683	2.4	3,808
May 23	1,481	3.4	3,915	October 31	1,661	2.3	3,601
May 26	1,666	3.7	4,723	November 3	1,468	2.0	3,108
June 2	1,667	3.85	4,109	November 6	1,429	1.9	3,006
June 5	1,834	4.1	6,293	November 10	1,313	1.7	2,650
June 9	1,415	3.2	3,198	November 13	1,299	1.7	2,691
June 18	5,849	11.6	33,972	November 17	1,311	1.7	2,648
June 20	4,195	8.4	19,099	November 21	1,284	1.6	2,605
June 23	3,516	7.1	12,600	November 26	1,252	1.5	2,568
June 26	3,658	6.8	13,329	December 1	1,250	1.5	2,593
July 3	3,517	5.8	10,263	December 4	1,242	1.5	2,586
July 7	4,776	8.6	27,358	December 8	1,143	1.4	2,398
July 10	3,078	5.3	10,966	December 11	1,135	1.4	2,384
July 14	3,657	5.9	12,415	December 15	1,131	1.4	2,488
July 18	2,824	5.1	9,799	December 18	1,172	1.4	2,352
July 22	2,435	4.1	6,915	December 26	1,182	1.4	2,291

NOTE.—No discharge measurements made in March and April, 1903.

Discharge measurements of Rio Grande near Roma, Tex., in 1904.

[By H. P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	1,173	1.4	2,263	July 1	4,231	9.7	24,299
January 5	1,091	1.4	2,081	July 6	1,393	3.3	4,186
January 8	1,106	1.4	2,137	July 9	1,262	3.2	2,897
January 12	1,093	1.5	2,283	July 13	1,104	2.6	2,285
January 15	1,094	1.4	2,269	July 18	917	2.0	1,651
January 20	1,066	1.4	2,211	July 22	871	1.9	1,517
January 23	1,058	1.3	2,171	July 26	1,232	2.9	2,878
February 2	989	1.5	2,020	August 1	1,129	2.4	1,736
February 5	983	1.5	2,016	August 4	1,037	2.4	1,828
February 9	967	1.4	1,915	August 8	968	1.9	1,665
February 12	1,104	1.9	2,201	August 10	1,026	2.1	1,850
February 23	925	1.4	1,939	August 15	1,018	2.2	2,058
February 26	945	1.5	1,972	August 19	929	1.7	1,655
February 29	917	1.4	1,931	August 23	872	1.5	1,566
March 4	908	1.3	1,839	September 6	1,502	3.0	3,492
March 8	845	1.2	1,626	September 8	3,339	7.6	18,414
March 11	829	1.1	1,564	September 13	6,695	15.8	46,893
March 15	827	1.1	1,574	September 20	6,763	14.0	29,100
March 18	782	1.0	1,483	September 24	7,445	15.3	34,869
March 22	803	1.0	1,678	September 27	5,450	10.7	23,203
March 25	803	.9	1,461	September 30	5,045	9.1	20,304
April 5	2,217	3.9	7,767	October 7	4,779	7.3	18,912
April 8	1,460	2.3	2,552	October 11	3,892	6.2	15,235
April 12	1,059	1.4	1,581	October 14	4,496	6.9	17,081
April 15	911	1.2	1,397	October 18	5,495	9.4	26,139
April 19	765	1.0	1,243	October 20	5,649	9.7	28,661
April 22	843	1.2	1,470	October 28	5,071	8.4	22,373
April 26	724	.9	1,171	October 31	3,830	7.1	17,163
May 3	809	1.2	1,329	November 4	4,062	7.4	18,132
May 9	2,849	5.65	13,461	November 9	3,759	6.3	12,944
May 13	1,002	1.5	1,300	November 15	2,969	5.3	11,136
May 16	3,490	6.95	14,058	November 18	2,786	5.0	10,159
May 20	1,445	2.8	2,851	November 22	2,606	4.7	8,561
May 24	963	1.8	1,428	November 25	2,531	4.5	7,743
May 27	834	1.6	1,264	November 28	2,447	4.6	7,797
June 1	2,407	5.0	8,959	December 2	2,167	4.1	6,716
June 6	3,791	8.6	23,287	December 6	3,017	4.5	7,702
June 9	1,937	4.1	5,855	December 9	3,215	4.4	7,338
June 14	1,938	4.3	5,969	December 16	3,160	4.6	8,036
June 17	1,518	3.3	3,569	December 21	2,655	4.8	9,063
June 21	1,456	3.2	3,266	December 26	2,620	4.5	8,434
June 24	1,375	2.9	2,685	December 28	2,866	4.4	7,508

Discharge measurements of Rio Grande near Roma, Tex., in 1907.

[By H. P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	2,349	5.4	5,605	July 12	2,141	5.3	5,173
January 7	2,181	5.0	4,827	July 17	2,663	6.3	7,357
January 14	2,126	4.9	4,550	July 21	2,447	5.6	5,725
January 19	2,090	4.8	4,304	July 25	2,037	5.2	4,971
January 26	2,216	5.1	4,961	July 29	2,066	4.9	4,506
February 2	2,187	5.0	4,956	August 2	2,184	5.0	4,894
February 5	2,319	5.3	5,648	August 6	2,595	5.3	5,828
February 11	2,063	4.8	4,525	August 24	1,983	3.8	4,429
February 14	1,976	4.6	4,165	August 28	1,719	3.1	3,705
February 23	1,913	4.4	3,820	August 31	2,414	5.2	5,533
March 2	1,832	4.2	3,107	September 2	2,323	4.9	5,007
March 5	1,701	4.0	3,000	September 6	2,856	6.2	11,201
March 12	1,588	3.7	2,998	September 10	2,892	6.1	10,279
March 19	1,540	3.5	2,648	September 14	3,199	7.1	13,467
March 26	1,456	3.3	2,444	September 18	2,666	5.5	7,877
April 2	1,537	2.9	2,598	September 24	3,380	7.3	15,489
April 8	1,278	2.4	2,299	September 28	2,741	5.9	9,256
April 12	1,744	3.0	3,102	October 2	2,619	5.7	8,231
April 15	1,541	2.9	2,611	October 7	3,350	7.3	13,883
April 20	1,507	2.85	2,568	October 11	2,174	5.0	4,931
April 29	1,412	2.7	2,358	October 15	2,315	4.7	4,048
May 3	2,407	4.7	5,056	October 19	2,084	4.3	3,304
May 7	2,883	5.1	5,609	October 24	2,180	5.0	4,912
May 11	2,097	4.5	5,019	October 29	2,405	5.5	5,812
May 16	2,030	4.1	3,807	November 2	2,182	5.0	4,943
May 25	2,425	4.3	4,160	November 6	2,736	5.9	6,841
May 27	5,390	10.6	32,091	November 11	3,796	8.3	17,336
May 30	2,631	4.5	4,991	November 15	2,851	6.5	10,588
June 3	1,932	4.0	3,904	November 20	2,505	5.6	6,071
June 7	2,023	4.7	4,193	November 25	2,576	5.3	5,738
June 11	2,166	5.0	4,560	November 29	2,449	5.2	5,354
June 15	2,671	5.9	6,511	December 2	2,459	5.2	5,479
June 19	2,503	5.7	5,863	December 6	3,487	8.0	15,328
June 24	2,355	5.6	5,765	December 11	2,872	6.1	10,305
June 28	2,300	5.4	5,456	December 15	2,620	5.8	6,240
July 2	2,368	5.5	5,592	December 20	2,254	5.4	5,347
July 4	4,948	11.3	21,054	December 24	2,243	5.0	5,065
July 8	4,051	9.0	12,315	December 30	2,236	4.9	4,888

Discharge measurements of Rio Grande near Roma, Tex., in 1908.

[By H. P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	2,330	5.0	5,303	July 7	2,408	5.0	4,795
January 6	2,334	5.0	5,336	July 10	2,901	6.5	9,761
January 11	2,166	4.8	4,724	July 14	2,616	6.0	7,878
January 15	2,011	4.6	4,137	July 18	1,675	3.0	2,186
January 20	1,925	4.4	3,758	July 22	1,643	2.9	2,130
January 24	1,867	4.3	3,670	July 26	2,000	3.7	2,894
January 30	1,727	3.7	3,203	July 30	2,896	5.9	8,274
February 1	1,879	4.2	3,568	August 2	2,976	6.0	8,256
February 5	1,811	3.7	3,292	August 7	4,646	10.0	19,689
February 10	1,788	3.6	3,202	August 11	3,413	7.2	14,417
February 14	1,755	3.4	3,073	August 15	3,585	8.2	16,987
February 19	1,730	3.3	3,019	August 19	3,420	7.6	15,818
February 23	1,736	3.3	3,037	August 23	3,333	7.1	13,796
February 28	1,678	3.2	3,033	August 27	2,991	6.3	10,067
March 2	1,674	3.2	3,020	August 30	2,928	6.0	8,535
March 6	1,592	2.8	2,791	September 2	3,012	6.4	10,207
March 10	1,493	2.6	2,524	September 6	4,705	11.0	21,033
March 14	1,419	2.5	2,380	September 10	3,987	8.6	18,717
March 18	1,423	2.3	2,372	September 14	3,415	7.3	15,070
March 22	1,395	2.3	2,220	September 18	3,293	7.0	13,443
March 26	1,299	2.3	2,041	September 22	2,519	5.5	7,085
March 30	1,191	2.2	1,766	September 26	2,212	4.8	4,820
April 2	1,147	2.0	1,723	September 29	2,126	4.4	3,493
April 7	1,146	2.0	1,769	October 2	2,003	4.0	3,205
April 11	2,077	5.2	5,074	October 6	1,957	3.9	3,114
April 13	3,419	7.2	14,439	October 10	2,227	4.8	4,885
April 17	2,536	5.2	7,347	October 14	1,906	3.7	3,007
April 21	5,994	13.0	31,249	October 18	1,696	3.3	2,540
April 24	2,594	6.0	8,185	October 23	4,663	11.0	21,092
April 29	1,208	3.7	2,761	October 26	1,820	3.5	2,920
May 2	1,148	3.3	2,470	October 30	1,788	3.4	2,880
May 6	1,145	3.3	2,502	November 2	1,716	3.3	2,760
May 10	1,326	3.9	2,916	November 6	1,561	3.0	2,428
May 15	4,862	11.8	20,812	November 10	1,507	3.0	2,209
May 19	2,685	4.5	4,074	November 14	2,050	4.3	3,372
May 23	2,350	3.7	3,253	November 18	1,542	3.0	2,463
May 26	4,654	10.8	20,616	November 22	1,551	3.0	2,449
May 30	2,130	4.3	3,144	November 26	1,519	3.0	2,389
June 2	2,148	4.4	3,217	November 29	1,451	2.8	2,029
June 6	1,593	3.9	2,030	December 2	1,492	2.9	2,157
June 10	2,146	4.4	3,160	December 6	1,469	2.9	2,132
June 14	1,671	3.5	2,505	December 10	1,472	2.9	2,151
June 18	1,490	2.9	2,223	December 14	1,462	2.9	2,128
June 22	1,424	2.7	2,096	December 18	1,383	2.8	2,071
June 26	1,393	2.6	2,000	December 22	1,395	2.8	2,066
June 29	1,886	3.7	2,732	December 26	1,361	2.8	2,065
July 2	1,697	3.2	2,364	December 30	1,369	2.8	2,063

Daily gage height, in feet, of Rio Grande near Roma, Tex., from 1900 to 1904, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.[a]												
1									5.4	6.4	4.9	4.2
2									5.2	7.15	5.0	4.1
3									6.05	6.6	4.85	4.1
4									5.6	6.2	4.85	4.15
5									5.5	6.35	5.05	4.1
6									5.8	6.25	4.75	4.1
7									5.9	6.05	4.7	4.15
8									7.65	5.8	4.6	4.1
9									6.25	5.65	4.6	4.1
10									5.35	5.65	4.55	4.1
11									4.85	5.4	4.5	4.1
12									4.75	5.4	4.55	4.2
13									4.6	5.3	4.5	4.15
14								7.8	4.7	5.15	4.45	4.2
15								7.6	4.95	5.1	4.4	4.15

[a] Gage heights for 1900 complete so far as Mexican records exist.

Daily gage height, in feet, of Rio Grande near Roma, Tex., from 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.												
16								7.1	5.45	5.1	4.4	4.15
17								6.85	5.6	5.0	4.4	4.1
18								6.7	5.35	4.9	4.4	4.1
19								6.4	5.25	5.55	4.45	4.1
20								6.35	5.2	5.7	4.45	4.05
21								6.1	5.1	5.5	4.4	4.0
22								5.9	4.95	5.7	4.4	4.0
23								6.55	4.9	6.3	4.35	4.0
24								6.6	8.95	5.7	4.3	3.9
25								6.4	12.95	5.35	4.25	3.9
26								6.15	12.9	5.35	4.2	3.9
27								5.7	8.45	5.6	4.2	3.95
28								5.3	6.75	5.55	4.2	4.0
29								5.3	5.85	5.35	4.1	4.0
30								5.75	6.2	6.3	4.1	4.0
31								5.5	.....	5.3	.....	3.95
1901.												
1	3.9	3.9	3.55	3.0	4.05	4.0	4.2	4.15	3.55	3.9	5.3	3.55
2	3.95	3.9	3.6	2.9	6.7	3.9	3.55	4.3	3.35	3.8	4.75	3.6
3	4.05	3.9	3.85	2.9	5.7	4.0	3.35	4.25	5.2	3.7	4.6	3.6
4	4.0	3.9	3.8	2.8	4.25	4.35	3.25	4.8	5.2	3.6	4.45	3.65
5	4.05	3.8	3.8	2.8	3.9	4.75	3.05	4.75	4.55	3.7	4.3	3.7
6	4.05	3.9	3.7	2.7	3.8	4.05	2.9	4.6	5.0	3.65	4.1	3.75
7	3.95	3.9	3.65	2.7	3.8	4.0	2.9	4.6	3.8	3.6	4.0	3.75
8	3.95	3.8	3.6	2.8	3.95	4.0	2.9	4.8	3.5	3.65	4.0	3.8
9	3.9	3.8	3.6	2.8	5.65	4.0	3.35	4.75	3.5	3.85	4.0	3.75
10	3.9	3.8	3.55	2.8	6.0	4.0	3.25	4.65	3.35	3.75	4.0	3.7
11	3.9	3.8	3.5	2.9	4.7	4.05	2.95	4.75	7.25	3.6	3.9	3.65
12	4.0	3.8	3.5	2.9	4.2	4.15	2.95	4.8	5.2	4.05	3.95	3.6
13	4.0	3.8	3.5	2.9	4.1	4.2	3.0	4.8	4.85	5.05	4.15	3.55
14	3.85	3.7	3.5	2.9	3.85	4.15	2.9	4.7	4.45	4.8	4.25	3.5
15	3.8	3.7	3.45	2.9	3.7	4.0	2.8	4.65	4.0	3.9	4.2	3.5
16	3.8	3.7	3.4	2.8	3.7	3.95	2.8	4.45	4.15	3.65	4.2	3.45
17	3.85	3.7	3.4	2.75	3.7	3.95	2.75	4.25	4.85	3.55	4.2	3.5
18	3.9	3.7	3.3	2.7	3.6	4.0	2.7	3.9	4.8	3.45	4.2	3.5
19	3.75	3.7	3.3	2.65	4.3	4.1	2.7	4.0	4.65	3.45	4.2	3.45
20	3.8	3.7	3.2	2.6	4.25	4.1	3.05	3.9	4.2	3.5	4.2	3.4
21	3.8	3.65	3.2	2.6	3.95	4.1	2.85	3.75	3.95	3.5	4.15	3.4
22	3.8	3.65	3.2	2.6	3.6	3.85	3.4	3.55	3.95	5.15	4.05	3.4
23	3.8	3.6	3.15	2.6	3.65	3.6	3.8	3.45	4.75	4.05	3.95	3.4
24	3.9	3.6	3.1	2.6	3.7	3.35	3.6	3.95	5.1	3.55	3.85	3.3
25	3.95	3.6	3.1	2.6	3.95	3.25	3.3	4.5	5.0	4.25	3.75	3.3
26	4.0	3.5	3.05	2.6	6.6	3.15	3.35	4.7	5.35	4.0	3.65	3.25
27	4.1	3.5	3.0	2.55	4.65	3.2	3.35	4.55	4.85	4.0	3.6	3.2
28	4.05	3.5	3.0	2.5	4.35	4.85	3.15	4.45	4.6	4.0	4.4	3.2
29	4.0	.....	3.0	2.55	3.95	6.55	3.4	4.35	4.35	3.95	4.8	3.2
30	3.95	.....	3.0	2.6	3.75	5.3	3.9	4.1	4.2	4.25	3.9	3.2
31	3.9	.....	3.0	.....	4.0	.....	3.95	3.75	.....	5.3	.....	3.2
1902.												
1	3.2	2.9	2.75	1.95	1.85	2.65	2.25	7.3	4.85	5.1	3.0	4.4
2	3.15	2.9	2.65	1.95	1.8	2.6	2.35	6.85	5.35	4.9	3.05	4.2
3	3.1	2.9	2.55	1.85	1.8	2.5	2.25	6.25	6.3	7.15	3.4	6.6
4	3.1	2.9	2.45	1.85	1.75	2.95	2.15	5.75	7.15	6.7	3.6	5.5
5	3.1	2.9	2.4	1.9	1.85	3.05	4.0	5.5	6.25	5.0	3.0	4.55
6	3.1	2.9	2.4	1.9	5.9	3.0	3.6	5.25	5.75	4.5	3.0	3.85
7	3.1	2.9	2.35	1.85	7.15	2.8	3.15	5.05	6.1	4.45	2.8	3.55
8	3.1	2.9	2.3	1.8	5.6	2.55	2.65	4.80	7.0	4.4	2.9	4.0
9	3.1	3.0	2.3	1.9	4.2	2.45	2.35	4.35	7.7	4.4	3.35	3.8
10	3.1	3.0	2.3	1.9	3.85	2.35	2.15	4.3	7.6	4.35	3.7	3.0
11	3.1	3.0	2.3	1.8	3.65	2.3	2.1	4.6	9.3	3.75	3.35	5.0
12	3.25	3.0	2.25	1.8	3.3	2.25	2.05	4.15	10.5	3.75	3.4	3.55
13	3.4	2.95	2.2	1.8	3.05	2.05	2.05	3.95	9.7	3.7	3.5	2.9
14	3.5	2.9	2.2	2.25	2.9	2.0	2.3	3.8	8.7	6.05	3.7	2.9
15	3.55	2.9	2.15	3.3	2.9	2.0	2.65	4.0	8.15	7.7	3.0	3.1
16	3.75	2.9	2.15	3.65	2.8	2.0	3.7	3.95	7.75	8.65	2.95	2.95
17	3.5	2.9	2.15	3.5	2.7	2.1	5.25	5.85	6.85	6.65	2.9	2.9
18	3.4	2.9	2.1	4.25	2.6	2.45	4.45	5.3	6.3	5.45	2.9	2.9
19	3.35	2.9	2.1	4.6	2.5	2.65	4.0	4.8	6.55	4.4	2.95	2.9
20	3.3	2.85	2.1	3.4	4.8	2.55	3.65	4.85	6.5	4.3	2.65	2.9

Daily gage height, in feet, of Rio Grande near Roma, Tex., from 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
21	3.25	2.8	2.05	3.0	7.95	2.45	3.5	4.9	6.65	4.1	2.85	2.85
22	3.2	2.8	2.05	2.85	4.95	2.5	3.5	4.65	5.6	3.7	2.85	2.8
23	3.15	2.7	2.05	2.55	3.85	3.05	3.5	4.8	5.1	3.6	4.4	2.8
24	3.1	2.6	2.1	2.4	3.4	2.75	3.5	4.7	5.1	3.45	3.8	2.8
25	3.05	2.6	2.0	2.25	3.25	2.9	3.8	4.5	5.6	3.4	3.5	2.8
26	3.0	2.7	2.1	2.15	3.2	3.05	3.95	4.75	4.85	3.3	3.0	2.8
27	3.0	2.65	2.05	2.0	3.15	3.0	5.55	4.65	4.6	3.2	3.15	2.8
28	2.9	2.6	2.0	2.0	3.0	2.6	9.95	5.05	4.45	3.15	3.0	2.8
29	2.9	.....	2.0	2.0	2.9	2.35	9.5	4.85	4.3	3.1	3.1	2.8
30	2.9	.....	1.9	1.9	2.9	2.2	7.6	3.65	4.75	3.05	3.6	2.8
31	2.9	.....	1.9	.....	2.9	.....	7.5	4.3	.....	3.0	.....	2.8
1903.												
1	2.8	2.65	.....	.....	5.6	3.6	6.35	12.65	4.25	5.25	2.2	1.5
2	2.8	2.7	.....	.....	4.45	3.95	6.0	9.4	5.0	4.7	1.95	1.5
3	2.75	2.65	.....	.....	3.25	4.0	5.75	7.05	4.05	4.7	2.0	1.5
4	2.7	2.65	.....	.....	3.35	5.25	5.45	5.1	3.55	5.15	1.95	1.5
5	2.7	2.65	.....	.....	3.35	3.85	6.1	4.3	3.55	5.75	1.9	1.5
6	2.7	2.7	.....	.....	3.55	3.65	8.6	3.8	5.3	5.5	1.9	1.5
7	2.75	2.75	.....	.....	2.85	3.65	8.65	3.55	5.5	5.9	1.8	1.4
8	2.75	2.8	.....	.....	2.7	3.65	6.45	3.3	5.3	5.7	1.9	1.4
9	2.7	2.7	.....	.....	2.8	3.2	5.45	3.8	5.3	5.9	1.8	1.4
10	2.7	2.7	.....	.....	3.25	3.55	5.35	3.7	5.0	4.6	1.7	1.4
11	2.7	2.65	.....	.....	3.65	4.35	5.6	3.7	12.85	4.15	1.7	1.4
12	2.65	2.6	.....	.....	3.15	4.95	5.8	4.25	8.85	3.95	1.7	1.4
13	2.75	2.6	.....	1.9	3.5	10.9	5.9	3.6	5.8	3.8	1.7	1.4
14	2.8	2.5	.....	1.8	5.25	15.75	5.9	3.3	4.65	3.7	1.7	1.4
15	2.9	2.45	.....	1.8	5.25	18.5	5.85	3.2	3.75	3.5	1.6	1.4
16	3.0	2.4	.....	1.8	3.9	19.25	5.6	4.5	3.45	3.45	1.6	1.4
17	3.0	2.4	.....	1.9	3.35	17.0	5.25	4.8	3.25	3.45	1.6	1.4
18	2.85	3.45	.....	1.75	4.25	11.4	5.0	4.15	3.35	2.85	1.6	1.4
19	2.8	3.2	.....	1.7	6.35	8.3	4.8	3.95	5.0	2.7	1.6	1.4
20	2.75	3.2	.....	1.65	5.1	8.2	4.3	4.15	4.25	2.65	1.6	1.4
21	2.9	3.1	.....	1.6	4.05	7.6	4.2	4.0	3.9	2.6	1.6	1.4
22	3.0	3.0	.....	1.6	3.5	7.3	3.95	3.45	3.95	2.6	1.55	1.4
23	2.9	3.1	.....	1.55	3.4	7.05	3.7	3.3	3.85	2.5	1.5	1.4
24	2.9	3.0	.....	1.5	4.15	6.95	3.5	3.25	3.65	2.45	1.5	1.4
25	2.9	3.0	.....	1.6	4.15	6.8	3.4	3.3	3.5	2.4	1.5	1.4
26	2.75	3.0	.....	1.95	3.7	6.8	3.35	4.2	3.7	2.4	1.5	1.4
27	2.7	3.0	.....	2.15	3.6	6.95	3.15	4.35	3.55	2.35	1.5	1.4
28	2.7	3.15	.....	1.85	3.6	6.75	5.05	4.1	3.7	3.6	1.5	1.4
29	2.7	.....	.....	3.3	3.65	6.55	6.9	3.75	4.85	2.8	1.5	1.4
30	2.7	.....	.....	3.1	3.6	6.45	4.9	3.4	6.25	2.4	1.5	1.4
31	2.7	.....	.....	.....	4.05	.....	10.9	3.25	.....	2.25	.....	1.4
1904.												
1	1.4	1.5	1.4	.95	.9	5.25	9.0	2.4	1.95	8.75	7.3	4.2
2	1.4	1.5	1.4	1.0	1.55	4.05	5.95	2.7	2.2	8.1	8.3	4.1
3	1.4	1.5	1.3	4.3	1.6	3.55	4.75	2.65	2.75	8.65	7.6	4.1
4	1.4	1.5	1.3	4.6	7.0	3.35	4.3	2.4	2.85	8.15	7.4	4.1
5	1.4	1.5	1.3	4.15	4.45	3.2	3.65	2.2	2.7	7.65	7.05	4.1
6	1.4	1.5	1.3	3.05	2.65	7.87	3.35	2.1	2.85	7.2	6.7	4.35
7	1.4	1.5	1.3	2.75	1.8	7.05	3.2	2.0	3.6	7.25	6.45	4.05
8	1.4	1.5	1.2	2.4	1.8	6.8	3.2	1.9	7.2	6.6	6.5	4.35
9	1.4	1.45	1.1	2.0	4.8	4.2	3.1	2.0	10.7	6.3	6.3	4.5
10	1.4	1.5	1.1	1.75	3.0	4.35	3.0	2.1	9.85	6.1	6.2	4.85
11	1.45	1.7	1.1	1.55	1.9	4.35	2.85	2.3	11.15	6.15	6.1	4.85
12	1.5	2.05	1.1	1.4	1.75	3.9	2.7	2.65	9.9	6.1	5.85	4.6
13	1.4	1.6	1.0	1.3	2.6	3.2	2.6	2.55	16.0	6.2	5.6	4.45
14	1.4	1.5	1.0	1.25	4.6	4.4	2.6	2.4	17.5	6.9	5.4	4.3
15	1.4	1.6	1.1	1.2	4.5	4.1	2.45	2.25	22.65	7.3	5.3	4.3
16	1.4	1.75	1.1	1.1	7.25	4.0	2.25	2.3	25.75	8.8	5.2	4.6
17	1.5	1.6	1.0	1.1	6.5	3.45	2.05	2.0	25.7	9.95	5.15	4.2
18	1.5	1.5	1.0	1.0	5.45	3.4	2.0	1.95	24.75	9.5	5.0	4.2
19	1.5	1.4	1.0	1.0	3.8	3.4	1.9	1.75	18.25	9.75	5.0	4.3
20	1.4	1.45	1.0	.9	2.85	3.2	1.9	1.65	14.4	9.7	4.9	4.4
21	1.4	1.5	1.0	.9	2.65	3.05	1.95	1.65	13.65	10.35	4.8	4.7
22	1.4	1.5	1.0	1.2	2.4	3.5	1.9	1.5	13.4	10.65	4.7	4.4
23	1.3	1.4	1.0	1.05	2.05	3.15	1.9	1.5	14.85	9.5	4.7	4.4
24	1.3	1.4	1.0	1.0	1.85	2.9	2.0	1.5	15.1	9.4	4.6	4.4
25	1.3	1.5	.9	.9	1.8	2.6	3.35	1.7	14.1	9.35	4.5	4.25

Daily gage height, in feet, of Rio Grande near Roma, Tex., from 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
26	1.4	1.5	0.9	0.9	1.75	3.0	2.9	1.65	12.0	9.05	4.55	4.4
27	1.4	1.4	1.0	1.0	1.65	3.55	4.5	1.55	10.9	8.8	4.6	4.4
28	1.4	1.4	.9	1.6	1.5	3.25	3.55	1.6	10.15	8.45	4.6	4.4
29	1.4	1.4	.9	1.15	3.1	3.0	3.15	1.45	9.7	8.05	4.7	3.9
30	1.4	.....	.9	1.1	3.35	9.0	2.95	1.45	9.2	7.55	4.6	3.9
31	1.4	.....	.9	.....	3.5	.....	2.8	1.65	.....	7.15	.....	3.8
1907.												
1	5.4	4.9	4.25	3.05	2.8	4.9	5.45	5.4	5.25	5.8	5.1	5.2
2	5.4	4.95	4.2	2.9	4.3	4.35	5.55	5.25	4.9	5.7	5.0	5.2
3	5.3	5.2	4.0	2.9	4.75	4.05	5.7	5.3	4.8	5.7	5.4	5.4
4	5.15	5.3	4.0	2.8	5.4	4.0	10.25	5.45	4.95	5.4	5.5	5.3
5	5.1	5.25	3.95	2.8	5.5	4.0	6.5	5.5	5.65	5.15	5.7	6.8
6	5.0	5.0	3.9	2.65	5.2	4.65	6.0	5.3	6.2	5.0	6.0	7.6
7	5.0	5.0	3.8	2.5	5.1	4.75	6.25	5.15	5.85	7.6	6.0	7.5
8	5.0	5.1	3.8	2.4	4.9	4.9	8.0	4.95	6.25	9.0	6.1	6.9
9	5.0	5.0	3.7	2.4	4.6	4.95	6.75	4.8	6.2	6.8	6.3	6.55
10	5.0	4.9	3.7	2.4	5.0	5.05	5.75	4.95	6.25	5.05	8.5	6.35
11	5.0	4.8	3.7	2.9	4.5	5.2	5.4	5.1	7.45	5.0	9.1	6.25
12	5.0	4.7	3.7	3.05	4.15	5.2	5.4	4.85	6.4	4.9	8.5	6.1
13	5.0	4.6	3.7	3.1	4.45	5.4	5.5	4.75	7.1	4.8	7.55	6.0
14	4.9	4.55	3.7	3.0	4.35	5.9	5.8	4.55	7.3	4.55	6.9	5.95
15	5.0	4.4	3.7	2.9	4.25	5.85	5.95	4.45	6.35	4.5	6.4	5.85
16	5.0	4.4	3.7	2.95	4.1	5.65	6.15	4.55	5.95	4.5	6.25	5.75
17	5.0	4.4	3.6	3.0	4.1	5.5	6.2	4.6	5.8	4.5	6.1	5.55
18	5.0	4.4	3.5	3.0	4.3	5.5	5.75	4.45	5.5	4.4	6.0	5.4
19	4.9	4.4	3.5	2.95	4.3	5.6	5.65	4.35	5.5	4.4	5.85	5.4
20	4.9	4.4	3.5	2.85	4.3	5.3	5.85	4.15	5.95	4.3	5.65	5.4
21	4.95	4.4	3.5	3.0	4.5	5.3	5.75	4.05	5.7	4.3	5.55	5.3
22	5.0	4.4	3.5	3.0	5.5	5.25	5.6	3.85	6.75	4.2	5.5	5.15
23	5.0	4.4	3.5	2.9	5.4	5.45	5.5	3.8	7.35	4.35	5.4	5.0
24	5.0	4.4	3.4	2.8	4.95	5.6	5.45	3.7	7.25	5.05	5.4	5.0
25	5.0	4.4	3.35	2.8	4.25	5.7	5.3	3.25	6.9	4.95	5.3	4.95
26	5.05	4.4	3.3	2.8	4.15	5.6	5.2	3.1	6.4	4.85	5.3	4.9
27	4.9	4.4	3.3	2.8	8.8	5.4	5.25	3.1	5.85	4.95	5.2	4.9
28	4.9	4.4	3.3	2.8	6.25	5.4	5.05	3.05	5.85	5.5	5.1	4.9
29	4.8	.....	3.3	2.7	4.85	5.4	5.1	3.0	5.7	5.5	5.15	4.9
30	4.8	.....	3.3	2.7	4.35	5.35	5.25	3.0	5.75	5.5	5.2	4.9
31	4.8	.....	3.2	.....	4.0	.....	5.25	5.3	.....	5.5	.....	4.85
1908.												
1	4.9	4.2	3.2	2.1	3.5	4.25	3.5	5.1	6.65	4.15	3.2	2.9
2	5.0	4.0	3.2	2.3	3.3	4.3	3.15	6.05	6.3	4.0	3.3	2.95
3	5.05	3.8	3.0	2.3	3.2	3.95	3.0	6.2	7.1	3.95	3.15	3.0
4	5.0	3.7	2.9	2.2	3.2	3.75	2.95	5.4	6.8	3.9	3.0	3.0
5	4.95	3.65	2.9	2.3	4.0	3.6	2.75	5.25	8.35	3.8	3.0	2.95
6	4.9	3.6	2.75	2.1	4.0	3.85	3.1	5.15	9.75	3.7	3.0	2.9
7	4.9	3.6	2.7	2.05	4.0	4.45	4.95	9.75	8.65	3.6	3.0	2.9
8	4.8	3.6	2.7	2.0	4.0	4.4	4.2	8.45	8.45	5.3	3.0	2.9
9	4.8	3.5	2.6	2.35	4.0	4.35	3.2	8.55	8.65	5.75	3.0	2.9
10	4.8	3.6	2.6	2.7	4.0	4.35	6.25	7.9	8.55	4.85	3.0	2.9
11	4.7	3.45	2.6	5.05	4.0	4.05	5.0	7.15	7.8	4.5	2.9	2.9
12	4.65	3.4	2.5	7.4	4.0	3.85	4.75	6.8	7.1	4.15	3.05	2.9
13	4.6	3.4	2.5	6.95	4.0	3.65	4.6	6.65	6.65	4.0	3.75	2.9
14	4.6	3.4	2.5	5.9	4.0	3.45	5.9	6.5	7.4	3.7	4.2	2.9
15	4.5	3.3	2.5	5.75	11.6	3.25	4.55	7.45	8.95	3.5	3.75	2.9
16	4.5	3.3	2.4	4.25	6.8	3.1	4.05	10.0	8.15	3.35	3.45	2.9
17	4.4	3.3	2.4	5.2	5.9	3.05	3.65	10.1	7.25	3.3	3.25	2.8
18	4.4	3.3	2.3	4.7	5.2	2.95	3.15	8.85	6.85	3.3	3.05	2.8
19	4.4	3.3	2.3	4.0	4.25	2.9	2.95	7.5	6.25	3.2	3.0	2.8
20	4.4	3.3	2.3	3.8	3.5	2.9	2.75	7.2	5.85	3.15	3.0	2.8
21	4.4	3.3	2.3	10.15	3.2	2.8	2.65	7.1	5.65	3.0	3.05	2.8
22	4.3	3.3	2.3	10.8	3.1	2.7	2.75	7.1	5.45	2.9	3.0	2.8
23	4.3	3.3	2.3	7.15	3.55	2.6	2.5	6.7	5.25	9.1	3.0	2.75
24	4.3	3.3	2.3	5.95	3.0	2.6	2.45	6.45	5.05	5.5	3.0	2.75
25	4.2	3.2	2.3	4.7	11.0	2.6	2.5	6.45	4.85	4.05	3.0	2.8
26	4.2	3.1	2.3	4.45	10.75	2.7	3.55	6.3	4.65	3.45	2.95	2.8
27	4.1	3.0	2.3	4.2	7.95	2.6	3.55	6.3	4.55	3.4	2.9	2.8
28	4.1	3.1	2.2	3.65	6.65	3.1	4.45	6.45	4.35	3.35	3.0	2.8
29	3.8	3.1	2.2	3.6	5.2	4.0	5.8	6.75	4.25	3.35	2.85	2.8
30	3.7	.....	2.2	3.6	4.3	3.7	5.4	6.4	4.2	3.35	2.9	2.8
31	4.0	.....	2.2	.....	4.3	.....	5.1	6.25	.....	3.25	.....	2.9

RIO GRANDE NEAR BROWNSVILLE, TEX.

This station was established in 1900 by the International Boundary Commission. It is about 1 mile above Brownsville, Tex., and opposite Matamoros, Tamaulipas, Mexico, 900 miles by river below El Paso.

Between Roma and Brownsville there are many lagoons (old river beds) which take river water during moderate floods, and a large area overflows rather deeply in larger floods. Much of this water returns slowly to the river as the flood subsides, so that the flow passes Brownsville more uniformly than it does at Roma. Large quantities of water also leave the river entirely, reaching the Gulf of Mexico through channels remote from the Rio Grande. Local run-off, however, keeps the total water at Brownsville well up toward the combined flow of the San Juan and the Rio Grande at Roma. Both banks are alluvial and are just about level with high water. The right bank is protected by piling.

As the bed of the river is constantly shifting, frequent discharge measurements are made to determine closely the daily flow.

Discharge measurements and gage heights for the years 1900 to 1904, which have not hitherto been published by the United States Geological Survey, are given herewith, together with data for 1907–8.

The observations at this station have been made under the direction of the Mexican section of the International Boundary Commission.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1900.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 19	2,017	3.0	4,192	December 25	1,972	2.5	4,118
December 22	2,119	3.2	4,768	December 29	1,909	2.3	4,014

NOTE.—Discharge measurements for 1900 complete so far as Mexican records exist.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1901.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	1,864	2.2	3,587	June 26	1,598	1.4	2,812
January 7	1,818	2.0	3,579	June 30	2,586	4.4	9,806
January 11	1,826	2.05	3,744	July 1	4,548	11.0	27,956
January 12	1,798	2.0	3,662	July 5	1,642	4.0	4,427
January 16	1,854	2.05	3,836	July 8	1,770	3.2	3,386
January 19	1,758	2.0	3,548	July 12[a]	2,780	6.0	9,834
January 22	1,726	1.9	3,440	July 16[a]	1,857	3.0	2,813
January 26	1,663	1.8	3,335	July 20	1,678	1.8	2,434
January 30	1,677	1.7	3,237	July 24	1,538	1.5	2,152
February 2	1,698	1.6	3,644	July 28	1,714	1.8	2,451
February 5	1,660	1.5	3,655	August 1	1,487	1.5	2,217
February 9	1,590	1.5	3,502	August 5	1,833	2.2	3,116
February 13	1,600	1.4	3,505	August 9	2,136	2.9	3,775
February 16	1,594	1.4	3,150	August 13	2,129	2.9	3,753
February 20	1,560	1.2	3,128	August 17	2,190	3.0	4,125
February 24	1,581	1.15	3,117	August 21	1,946	2.2	3,461
February 27	1,521	1.1	3,000	August 25	1,734	1.6	2,816
March 2	1,470	1.0	2,745	August 29	2,008	2.2	3,621
March 6	1,481	1.05	2,773	September 2	2,020	2.1	3,473
March 9	1,550	1.2	3,189	September 6	3,744	7.9	14,731
March 13	1,462	.9	2,870	September 10	2,012	2.9	3,907
March 17	1,431	.8	2,762	September 14	2,934	5.45	9,680
March 20	1,393	.7	2,592	September 18	2,280	3.7	4,937
March 24	1,338	.6	2,463	September 22	2,943	4.75	6,236
March 28	1,302	.3	2,336	September 26	3,011	4.9	7,662
April 1	1,294	.3	2,306	September 30	3,278	7.3	14,461
April 4	1,273	.1	2,206	October 4	2,767	5.2	9,898
April 8	1,225	.0	1,996	October 8	2,666	4.0	4,834
April 12	1,213	.0	2,002	October 12	2,546	3.4	4,483
April 16	1,182	− .1	1,914	October 16	2,921	5.7	9,774
April 20	1,182	− .1	1,914	October 20	1,930	3.0	3,758
April 24	1,120	− .3	1,751	October 24	3,625	6.5	14,352
April 28	1,097	− .5	1,691	October 28	2,481	4.4	7,310
May 2	1,079	− .55	1,638	November 1	3,036	4.6	6,639
May 3	1,077	− .5	1,639	November 5	2,251	5.2	6,661
May 4	2,986	5.5	12,721	November 9	2,799	4.1	5,521
May 5	2,825	5.6	10,771	November 13	2,610	3.6	5,063
May 9	1,386	2.2	3,561	November 17	2,633	3.6	5,433
May 13	1,983	4.2	6,502	November 21	2,628	3.7	5,184
May 17	1,786	2.7	3,747	November 25	2,470	3.4	4,887
May 21	1,972	2.7	4,066	November 29	2,332	3.05	5,017
May 25	2,231	2.8	3,933	December 3	2,011	3.75	5,480
May 29	2,528	4.3	7,256	December 7	2,031	2.8	4,274
June 1	2,093	2.9	4,300	December 11	2,012	2.4	3,854
June 5	1,914	2.4	3,505	December 15	1,939	2.0	3,483
June 7	2,957	5.4	9,663	December 19	1,757	1.6	2,877
June 11	1,750	2.4	3,452	December 23	1,741	1.6	2,849
June 15	1,786	2.2	3,493	December 27	1,773	1.7	2,927
June 18	1,740	2.0	3,364	December 31	1,693	1.3	2,660
June 22	1,600	1.7	2,943				

[a] Measurements, July 12 and 16, 1901, by E. Zayas.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1902.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	1,664	1.1	2,653	July 9	1,113	0.4	1,917
January 8	1,637	1.0	2,637	July 13	1,271	.8	2,092
January 12	1,651	1.0	2,646	July 18	898	— .4	1,251
January 16	1,653	1.0	a 2,517	July 21	2,420	3.7	4,957
January 20	1,842	1.5	2,885	July 25	1,872	2.2	3,504
January 24	1,726	1.1	2,560	July 30	4,314	8.7	19,957
January 28	1,622	.9	2,259	August 3	4,436	9.0	21,254
February 1	1,592	.7	2,192	August 7	2,705	5.8	8,488
February 5	1,530	.6	2,092	August 11	2,726	4.6	5,660
February 9	1,544	.6	2,103	August 15	2,411	3.6	4,305
February 13	1,566	.6	2,213	August 19	3,040	5.1	7,677
February 17	1,525	.5	1,999	August 21	3,032	5.0	6,715
February 21	1,497	.45	2,001	August 21 b	3,038	5.0	6,922
February 25	1,437	.3	1,875	August 28	2,648	3.9	5,224
March 1	1,406	.2	1,932	August 30	2,700	4.0	5,622
March 5	1,352	.0	1,766	September 4	2,889	4.9	6,776
March 9	1,280	— .1	1,625	September 8	2,983	6.4	11,062
March 13	1,234	— .3	1,599	September 13	4,574	10.8	19,486
March 17	1,207	— .4	1,489	September 15	5,180	11.9	23,509
March 21	1,181	— .5	1,360	September 19	3,677	8.8	14,023
March 25	1,159	— .6	1,325	September 23	3,889	9.1	14,493
March 29	1,095	— .7	1,322	September 28	3,872	6.85	9,422
April 3	1,037	— .8	1,276	October 2	3,932	7.2	10,362
April 7	1,037	— .8	1,278	October 6	3,210	7.5	11,533
April 11	1,029	—1.0	1,178	October 10	2,518	4.7	5,506
April 15	1,023	—1.0	1,177	October 14	2,402	3.8	4,326
April 19	1,751	1.0	2,630	October 18	5,461	11.95	24,325
April 23	1,919	2.5	3,430	October 22	2,526	5.25	6,108
April 27	1,141	.5	1,799	October 26	2,300	3.9	4,046
May 3	829	— .8	1,126	October 29	2,106	3.3	3,368
May 7	815	— .9	1,099	November 3	2,232	3.8	4,047
May 10	2,707	5.8	10,258	November 7	1,857	2.7	3,144
May 15	1,719	2.45	2,737	November 11	1,944	3.1	3,525
May 20	1,268	1.0	1,674	November 14	1,918	3.0	3,556
May 24	2,592	4.7	7,075	November 18	1,653	2.1	2,786
May 28	1,561	2.0	2,389	November 23	1,455	1.5	2,210
June 2	1,206	.9	1,656	November 27	1,688	1.95	2,870
June 6	1,031	.3	1,381	December 2	1,645	1.7	2,727
June 10	1,132	.6	1,565	December 5	4,202	8.4	15,232
June 13	947	.1	1,254	December 10	2,490	3.8	4,746
June 18	794	— .3	1,025	December 15	2,040	2.1	3,182
June 23	895	— .1	1,198	December 17	1,938	1.9	2,937
June 27	900	— .1	1,201	December 21	1,772	1.5	2,571
July 1	1,023	.3	1,601	December 26	1,708	1.2	2,443
July 5	822	— .4	1,216				

a Measurement, January 16, 1902, affected by wind, rejected.
b Measurement, August 21, 1902, by E. Zayas.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1903.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	1,646	1.1	2,361	August 2	5,941	12.2	29,898
January 7	1,584	1.0	2,294	August 7	4,113	8.2	11,146
January 12	1,559	.9	2,257	August 11	3,094	5.3	5,752
January 16	1,594	1.0	2,313	August 15	3,078	5.2	5,624
January 20	1,710	1.45	2,797	August 19	5,809	12.2	31,670
January 25	1,755	1.5	2,830	August 23	3,151	6.8	9,695
January 29	1,636	1.1	2,534	August 28	2,817	5.3	8,308
February 3	1,624	1.0	2,492	September 1	2,843	4.8	4,952
February 7	1,524	.8	2,174	September 5	2,978	5.3	5,533
February 11	1,522	.8	2,185	September 10	3,361	6.2	7,757
February 15	1,509	.8	2,129	September 15	5,670	11.0	19,434
February 19	1,549	.9	2,239	September 19	2,870	5.3	6,072
February 23	1,951	1.8	3,132	September 24	2,935	5.5	6,275
February 27	1,915	1.7	3,100	September 28	2,672	4.7	5,471
May 1	1,276	.5	1,790	October 2	3,340	7.4	10,714
May 4	3,133	4.9	7,925	October 7	3,438	6.9	10,448
May 8	2,172	2.3	4,242	October 11	3,485	7.5	11,356
May 13	2,322	2.8	4,904	October 15	2,882	4.9	5,671
May 17	3,296	5.7	9,188	October 19	2,785	4.3	5,862
May 21	3,702	6.8	11,616	October 23	2,310	3.1	4,456
May 25	1,808	2.5	4,022	October 26	2,131	2.7	4,249
May 29	1,891	2.6	4,307	October 29	2,111	2.6	4,080
June 2	1,644	1.7	3,511	November 2	1,895	2.5	3,579
June 5	2,233	3.1	5,736	November 6	1,843	2.0	3,441
June 9	2,201	3.0	5,462	November 11	1,775	1.8	3,160
June 12	2,090	2.6	4,278	November 15	1,720	1.4	2,846
June 16	5,758	12.2	31,158	November 20	1,670	1.3	2,677
June 19	5,995	12.7	33,699	November 24	1,629	1.2	2,611
June 25	4,153	9.6	14,015	November 28	1,581	1.1	2,541
June 29	4,535	9.1	12,731	December 2	1,575	1.0	2,429
July 3	4,276	8.1	10,173	December 6	1,557	1.0	2,430
July 7	5,064	10.1	19,159	December 10	1,533	.9	2,236
July 12	3,109	7.1	7,685	December 14	1,487	.8	2,173
July 16	3,317	7.6	8,596	December 18	1,471	.8	2,140
July 20	3,682	6.2	7,776	December 22	1,467	.8	2,129
July 24	3,356	5.3	6,425	December 26	1,464	.8	2,135
July 29	2,902	4.2	5,495	December 30	1,443	.7	2,086

NOTE.—Discharge measurements for 1903 complete so far as Mexican records exist. None for March and April, 1903.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1904.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	1,430	0.7	2,077	June 29	2,065	2.4	3,351
January 7	1,424	.7	2,050	July 3	5,078	10.8	22,487
January 11	1,422	.7	2,054	July 7	2,664	4.5	5,711
January 15	1,418	.6	2,039	July 11	2,260	3.2	3,748
January 19	1,403	.5	1,981	July 16	1,714	2.0	2,336
January 23	1,397	.5	1,954	July 21	1,444	1.2	1,925
January 28	1,382	.4	1,910	July 25	1,339	.9	1,436
February 1	1,322	.2	1,876	July 29	2,791	4.6	5,945
February 5	1,338	.2	1,878	August 2	2,118	2.5	3,075
February 9	1,332	.2	1,853	August 6	1,802	1.5	2,398
February 13	1,340	.2	1,872	August 10	1,663	1.0	2,090
February 16	1,513	.7	2,299	August 14	2,029	1.9	2,677
February 20	1,300	.0	1,885	August 18	2,250	2.5	3,146
February 24	1,302	.0	1,889	August 22	1,703	1.3	2,341
February 28	1,358	.2	2,009	August 26	1,479	.5	1,945
March 3	1,316	.0	1,912	August 30	1,433	.4	1,736
March 7	1,213	— .3	1,678	September 3	1,299	.1	1,443
March 11	1,180	— .4	1,544	September 7	1,497	.7	1,718
March 15	1,159	— .6	1,382	September 11	5,537	11.7	25,168
March 19	1,157	— .6	1,451	September 14	5,888	12.5	27,490
March 23	1,147	— .7	1,420	September 19	6,068	12.9	29,203
March 27	1,133	— .7	1,373	September 24	6,068	12.9	29,407
March 30	1,141	— .7	1,391	September 29	6,146	12.7	27,874
April 3	1,084	— .5	1,278	October 3	5,890	12.5	27,369
April 5	3,897	7.6	7,901	October 12	4,769	10.2	22,087
April 10	1,594	2.7	3,863	October 16	5,056	10.9	23,900
April 14	1,338	1.0	1,998	October 20	5,897	12.5	27,276
April 19	975	— .0	1,328	October 24	5,871	12.7	27,516
April 23	903	— .3	1,205	October 29	5,926	12.6	28,586
April 28	914	— .3	1,208	November 3	5,843	12.4	25,218
May 2	1,158	.1	1,578	November 7	5,449	11.4	21,546
May 6	4,237	8.5	8,626	November 11	5,079	10.4	19,295
May 10	2,490	4.6	5,529	November 15	4,558	9.0	16,741
May 14	1,766	2.85	3,702	November 19	3,956	8.1	12,956
May 18	4,486	10.25	10,138	November 23	3,894	7.6	10,308
May 23	1,969	3.3	3,830	November 28	3,714	7.0	9,298
May 27	1,624	1.9	2,192	December 2	3,792	7.1	9,683
May 31	1,161	1.1	1,525	December 6	3,676	6.7	9,288
June 4	2,926	5.2	6,136	December 10	3,522	6.4	8,647
June 9	5,006	10.9	22,180	December 14	3,404	7.0	9,627
June 13	2,641	5.5	7,898	December 18	3,277	6.6	9,031
June 17	2,880	4.9	5,767	December 22	3,139	6.2	8,470
June 21	2,374	3.5	4,061	December 26	3,117	6.3	8,561
June 26	2,530	4.0	4,652	December 30	3,088	5.9	8,076

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Discharge measurements of Rio Grande near Brownsville, Tex., in 1907.

By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	2,767	5.3	6,199	July 6	6,013	13.4	30,296
January 7	2,731	5.0	6,148	July 10	6,126	13.7	30,885
January 11	2,649	4.7	5,797	July 14	3,528	7.3	8,675
January 15	2,593	4.5	5,573	July 18	3,715	7.75	9,648
January 19	2,566	4.4	5,437	July 22	3,487	6.8	8,221
January 23	2,524	4.2	5,292	July 26	3,211	6.2	7,464
January 27	2,540	4.3	5,362	July 30	2,972	5.5	6,377
January 31	2,571	4.3	5,407	August 3	2,877	5.2	6,018
February 3	2,541	4.2	5,299	August 7	2,904	5.3	6,104
February 7	2,597	4.4	5,483	August 11	2,777	4.9	5,814
February 11	2,573	4.3	5,366	August 15	2,660	4.5	5,562
February 15	2,490	4.0	5,097	August 19	2,495	4.0	5,187
February 19	2,258	3.5	4,596	August 23	2,422	3.7	4,948
February 23	2,170	3.2	4,386	August 27	2,032	2.6	3,422
February 28	2,151	3.1	4,323	August 31	1,939	2.3	3,156
March 4	2,129	3.0	4,246	September 3	2,060	3.0	4,141
March 7	2,070	2.7	4,075	September 7	3,265	5.7	11,453
March 11	2,054	2.5	4,033	September 11	3,658	7.8	12,752
March 15	1,892	2.3	3,402	September 15	3,598	8.0	12,854
March 19	1,906	2.4	3,503	September 19	3,270	6.7	10,641
March 23	1,870	2.2	3,341	September 23	3,733	8.3	13,574
March 27	1,783	1.8	3,138	September 27	3,536	8.7	13,178
March 31	1,759	1.7	3,095	September 30	2,977	7.0	10,645
April 2	1,742	1.7	3,055	October 3	2,925	6.9	10,207
April 6	1,736	1.6	3,044	October 7	2,640	6.0	9,077
April 10	1,676	1.3	2,897	October 10	4,628	11.4	19,340
April 14	1,654	1.2	2,830	October 14	2,932	5.8	6,152
April 18	1,814	2.1	3,163	October 16	2,574	4.8	5,152
April 22	1,806	2.1	3,185	October 22	2,447	4.4	4,843
April 26	1,783	1.9	3,136	October 26	2,464	4.6	4,934
April 30	1,710	1.6	2,985	October 30	2,729	5.4	5,642
May 2	1,877	2.2	3,283	November 3	2,929	7.0	10,270
May 6	3,712	7.8	14,593	November 7	2,880	6.8	10,030
May 10	2,760	5.1	6,015	November 11	3,528	8.6	13,278
May 14	2,978	6.0	6,604	November 15	4,275	10.6	18,174
May 18	2,610	4.7	5,773	November 19	3,518	7.9	11,531
May 22	2,474	4.1	5,437	November 23	3,548	6.9	8,696
May 28	2,791	5.4	6,290	November 27	3,384	6.4	8,147
May 30	5,606	13.3	31,604	November 30	3,278	6.1	7,703
June 3	2,884	5.7	6,604	December 3	3,328	6.2	7,904
June 7	2,707	5.1	6,011	December 7	4,611	9.9	20,476
June 11	2,732	5.4	6,126	December 11	3,799	8.2	12,154
June 15	3,063	6.1	7,977	December 15	3,629	7.7	11,599
June 19	3,238	6.6	8,322	December 19	3,435	7.1	10,943
June 21	4,095	8.25	13,193	December 23	3,356	6.6	8,146
June 25	3,936	8.0	12,749	December 27	3,202	6.1	7,561
June 29	3,590	7.1	10,312	December 31	3,138	5.6	7,108
July 3	3,374	6.4	9,633				

Discharge measurements of Rio Grande near Brownsville, Tex., in 1908.

[By P. Guerra.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	2,749	5.3	6,325	July 6	1,940	2.5	3,042
January 7	2,665	5.1	6,033	July 10	2,350	4.6	4,130
January 11	2,646	4.6	5,615	July 14	3,039	5.4	7,030
January 15	2,285	4.1	5,173	July 18	2,583	5.0	5,399
January 19	2,415	3.9	4,931	July 22	1,858	2.3	2,907
January 23	2,370	3.8	4,769	July 26	1,696	1.7	2,452
January 27	2,282	3.6	4,550	July 30	1,907	2.4	2,837
January 31	2,278	3.6	4,540	August 2	3,916	8.6	13,124
February 3	2,104	3.3	3,180	August 6	3,308	6.0	8,034
February 7	2,004	2.9	2,993	August 9	4,944	11.2	21,862
February 11	1,923	2.6	2,763	August 13	3,888	9.0	12,790
February 15	1,920	2.6	2,728	August 17	5,134	11.8	23,148
February 19	1,883	2.5	2,628	August 19	5,644	13.0	27,785
February 23	1,744	2.2	2,593	August 23	4,031	9.3	13,629
February 27	1,764	2.1	2,563	August 27	3,728	8.1	12,033
March 2	1,733	2.0	2,257	August 31	4,022	8.8	13,662
March 6	1,719	1.9	2,232	September 3	3,800	8.2	12,336
March 10	1,612	1.6	2,179	September 7	4,825	11.0	19,897
March 14	1,553	1.3	1,959	September 11	5,323	12.1	24,561
March 18	1,527	1.2	1,914	September 15	4,441	10.0	17,626
March 22	1,517	1.1	1,873	September 18	5,135	11.8	21,726
March 26	1,506	1.0	1,842	September 22	3,136	7.8	9,315
March 30	1,505	0.9	1,839	September 26	2,828	6.8	8,153
April 3	1,488	0.8	1,756	September 30	2,519	5.6	7,135
April 7	1,469	0.6	1,634	October 3	2,742	4.9	4,371
April 11	1,455	0.5	1,600	October 7	2,635	4.3	4,096
April 14	5,619	12.7	29,014	October 11	3,094	6.1	7,477
April 18	3,571	7.1	8,508	October 15	2,573	4.1	3,804
April 20	3,362	6.5	7,732	October 19	2,372	3.3	3,376
April 24	5,962	13.4	28,805	October 23	2,312	3.1	3,212
April 28	3,002	5.4	6,552	October 25	4,444	9.8	17,125
May 3	2,158	4.0	3,612	October 29	2,528	4.0	3,590
May 7	2,030	3.6	2,594	November 2	2,338	3.2	3,407
May 11	2,090	3.8	3,409	November 6	1,717	2.6	2,325
May 15	1,988	3.4	2,525	November 10	1,572	2.3	2,087
May 17	5,675	13.6	27,705	November 14	3,101	6.1	7,488
May 21	2,872	5.0	6,058	November 18	2,532	4.0	3,651
May 25	2,584	4.0	5,298	November 22	1,745	2.7	2,424
May 27	3,901	9.1	12,999	November 26	1,559	2.3	2,039
May 29	3,742	8.3	12,089	November 30	1,526	2.0	1,932
June 2	2,905	5.1	6,215	December 3	1,525	2.0	1,950
June 6	2,214	4.2	3,760	December 7	1,555	2.1	2,058
June 10	2,116	3.8	3,445	December 11	1,496	1.9	1,850
June 15	2,107	3.2	3,315	December 15	1,462	1.8	1,723
June 18	1,994	2.8	3,080	December 19	1,448	1.7	1,731
June 22	1,824	2.3	2,802	December 23	1,442	1.6	1,726
June 26	1,749	1.9	2,552	December 27	1,442	1.5	1,722
June 30	2,150	3.9	3,578	December 31	1,442	1.5	1,730
July 2	2,182	3.4	3,466				

Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1900 to 1904, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.[a]												
1					6.0	6.35	4.05	10.0	6.65	9.1		
2					8.9	6.05	3.9	9.15	6.5	8.2		
3					10.4	10.4	6.4	8.4	6.45	8.05		
4					9.1	12.5	7.25	8.0	6.3	8.7		
5					6.95	10.25	6.6	7.7	6.85	8.3		
6					5.4	8.25	5.5	7.4	7.35	7.65		
7					4.9	11.0	4.7	7.35	7.05	7.7		
8					4.55	10.9	4.9	8.15	7.4	7.6		
9					4.4	8.3	6.1	8.6	8.95	7.3		
10					4.2	6.65	5.7	9.25	10.45	6.95		
11					4.0	6.05	5.5	9.95	8.2	6.9		
12					3.95	6.0	5.15	12.1	6.6	6.75		
13					3.95	6.0	4.75	12.75	5.9	6.45		
14					3.9	5.75	4.65	12.95	5.55	6.4		
15					3.55	5.45	4.35	12.8	5.25	6.15		

[a] Gage heights for 1900 complete so far as Mexican records exist.

Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.												
16					3.45	5.3	3.95	11.95	5.1	5.95		
17					8.7	5.15	5.85	10.75	5.3	5.8		
18					11.95	5.0	10.05	9.8	5.85	5.55		
19					12.55	5.0	11.0	9.35	6.55	5.5		3.0
20					12.85	5.25	9.4	8.65	6.5	5.35		2.85
21					11.8	5.5	7.95	8.3	6.2	5.05		2.8
22					9.5	6.45	7.65	8.1	6.05	6.5		3.1
23					11.45	7.85	6.5	7.7	5.85	6.55		2.85
24					12.4	6.25	5.7	7.5	5.55	6.6		2.65
25					11.3	5.4	5.4	7.9	6.75	7.5		2.5
26					10.25	4.9	5.05	8.4	11.4	6.65		2.4
27					9.25	4.45	4.9	8.1	12.45	6.05		2.35
28					8.3	4.2	4.8	7.7	12.9	5.95		2.3
29				5.75	7.7	4.2	5.65	7.0	12.6	6.5		2.3
30				7.1	7.2	4.2	5.5	6.45	10.45	6.5		2.3
31					6.7		7.7	6.3		7.1		2.3
1901.												
1	2.3	1.65	1.0	.3	−.5	3.0	10.15	1.5	2.25	5.5	4.5	5.95
2	2.3	1.6	1.0	.25	−.5	2.55	11.6	1.6	2.05	4.75	5.9	4.55
3	2.2	1.6	1.0	.2	−.4	2.5	8.75	1.8	1.85	4.75	5.8	3.65
4	2.2	1.6	1.0	.15	5.3	2.5	5.35	1.95	2.1	5.2	5.35	3.25
5	2.2	1.55	1.0	.1	5.75	2.4	4.15	2.15	7.75	4.85	5.2	3.05
6	2.0	1.5	1.0	.1	3.8	3.25	3.65	2.25	7.35	4.4	4.85	2.95
7	2.0	1.5	1.1	.1	2.9	5.5	3.2	2.5	5.5	4.05	4.45	2.75
8	2.0	1.5	1.1	.0	2.4	4.2	2.95	2.9	4.6	3.95	4.25	2.6
9	2.0	1.5	1.2	.0	2.2	3.1	2.8	2.95	3.45	3.8	4.1	2.5
10	2.0	1.5	1.1	.0	2.6	2.55	2.75	2.9	2.95	3.65	3.95	2.5
11	2.0	1.5	1.0	.0	5.6	2.4	4.75	2.9	2.55	3.55	3.65	2.4
12	2.0	1.5	1.0	.0	5.95	2.3	6.1	3.0	4.25	3.5	3.6	2.3
13	2.0	1.4	.9	.0	4.4	2.25	4.75	2.95	7.65	3.35	3.55	2.2
14	2.0	1.4	.9	.0	4.2	2.2	4.05	2.9	5.15	3.85	3.5	2.1
15	2.0	1.4	.9	− .1	3.75	2.2	3.6	2.95	4.3	8.1	3.5	2.0
16	2.0	1.4	.9	− .1	2.95	2.15	3.1	3.0	3.85	6.4	3.5	1.9
17	2.0	1.4	.8	− .1	2.65	2.1	2.6	3.0	3.6	3.9	3.6	1.8
18	2.0	1.4	.8	− .1	2.35	2.0	2.3	2.8	3.7	3.35	3.65	1.75
19	2.0	1.4	.8	− .1	2.25	1.9	2.0	2.65	4.5	3.15	3.7	1.65
20	1.9	1.2	.75	− .1	2.1	1.75	1.85	2.45	5.35	2.95	3.7	1.6
21	1.9	1.2	.7	− .2	2.55	1.7	1.75	2.25	5.25	2.75	3.7	1.6
22	1.9	1.2	.6	− .2	3.55	1.7	1.55	1.95	4.75	2.6	3.7	1.6
23	1.9	1.2	.6	− .3	3.65	1.7	1.5	1.8	4.25	2.8	3.6	1.6
24	1.8	1.25	.6	− .3	3.1	1.6	1.45	1.75	3.7	6.35	3.5	1.5
25	1.8	1.1	.5	− .3	2.65	1.55	1.4	1.55	3.9	5.55	3.4	1.5
26	1.8	1.1	.45	− .35	2.35	1.45	1.6	1.45	4.85	4.6	3.25	1.5
27	1.8	1.1	.4	− .4	3.45	1.2	1.8	1.5	6.3	4.9	3.05	1.6
28	1.8	1.1	.3	− .5	5.5	1.05	1.8	1.85	9.1	4.45	2.9	1.4
29	1.8		.3	− .5	4.3	.95	1.7	2.1	9.1	4.15	3.05	1.35
30	1.7		.3	− .5	3.8	4.35	1.55	2.35	7.45	4.1	6.3	1.3
31	1.7		.3		3.55		1.5	2.4		4.1		1.3
1902.												
1	1.2	.7	.1	− .8	−.45	1.0	.3	11.0	6.05	6.25	3.2	1.85
2	1.2	.7	.1	− .8	−.65	.85	.25	10.05	5.55	7.05	3.75	1.7
3	1.1	.6	.1	− .8	−.75	.75	.05	8.8	5.0	9.8	3.85	4.7
4	1.1	.6	.1	− .8	−.8	.65	− .15	9.1	5.0	10.15	3.4	6.6
5	1.05	.6	.0	− .8	−.8	.45	− .35	7.9	7.85	10.3	2.95	8.3
6	1.0	.6	.0	− .8	−.85	.35	− .4	6.3	7.65	8.0	2.7	6.7
7	1.0	.6	.0	− .8	−.9	.3	− .4	5.65	6.75	5.9	2.6	4.95
8	1.0	.6	−.5	− .9	3.7	.3	− .25	5.35	6.4	5.0	3.1	4.2
9	1.0	.6	−.15	− .9	7.87	.5	.5	5.1	7.5	4.7	3.5	3.65
10	1.0	.6	−.25	−1.0	6.67	.6	1.05	5.0	8.5	4.7	3.3	3.9
11	1.0	.6	−.3	−1.0	4.1	.45	1.3	4.45	9.35	4.6	3.0	3.95
12	1.0	6	−.3	−1.0	3.2	.25	1.15	4.05	9.8	4.55	2.75	3.35
13	1.0	.6	−.3	−1.0	3.05	.05	.7	3.9	10.85	4.15	2.8	2.65
14	1.0	.6	−.35	−1.0	2.8	−.1	.25	4.0	11.6	3.8	2.95	2.25
15	1.0	.6	−.4	−1.0	2.4	−.2	− .1	3.6	11.95	3.45	2.8	2.1
16	1.0	.6	−.4	−1.0	2.05	−.2	− .25	3.2	12.0	7.6	2.55	2.0
17	1.1	.5	−.4	− .9	1.75	−.2	− .35	2.95	11.7	10.9	2.45	1.85
18	1.3	.5	−.5	− .25	1.4	−.3	− .4	2.75	10.7	12.05	2.2	1.7
19	1.35	.5	−.5	.8	1.15	−.4	−1.75	4.35	9.05	11.25	1.95	1.65
20	1.45	.5	−.5	5.1	.95	−.5	3.7	5.5	8.05	7.4	1.75	1.55

Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
21	1.4	0.5	−0.5	5.2	0.75	−0.55	3.8	5.15	7.65	5.75	1.65	1.5
22	1.25	.4	− .6	3.35	2.8	− .3	3.4	4.85	10.2	5.2	1.5	1.5
23	1.15	.4	− .6	2.4	6.7	− .15	3.2	4.7	8.9	5.0	1.5	1.4
24	1.1	.4	− .6	1.75	4.4	− .1	2.5	4.65	7.15	4.45	1.5	1.3
25	1.05	.3	− .6	1.35	2.9	− .1	2.15	4.45	6.6	4.15	1.45	1.3
26	1.0	.3	− .6	.9	2.4	− .1	1.95	4.3	7.45	3.85	1.45	1.2
27	.95	.3	− .6	.5	2.15	− .1	1.85	4.1	7.2	3.65	2.0	1.2
28	.9	.1	− .6	.1	1.9	.15	2.25	3.95	6.7	3.5	2.3	1.2
29	.8	.....	− .7	− .1	1.7	.2	5.55	3.85	5.85	3.35	2.15	1.2
30	.8	.....	− .7	− .35	1.4	.2	9.0	3.95	5.45	3.15	1.95	1.15
31	.7	.....	− .8	.....	1.2	.....	10.6	5.4	.....	3.1	.....	1.1
1903.[a]												
1	1.1	1.0	.....	.....	− .5	1.75	8.85	9.25	4.9	4.35	3.65	1.0
2	1.1	1.0	.....	.....	− .45	1.7	8.65	12.2	4.6	7.2	2.85	1.0
3	1.05	1.0	.....	.....	2.4	1.7	8.2	12.65	4.5	6.75	2.5	1.0
4	1.0	.9	.....	.....	4.75	1.6	7.7	12.8	5.0	5.85	2.35	1.0
5	1.0	.8	.....	.....	3.3	2.35	7.25	13.0	5.3	5.75	2.2	1.0
6	1.0	.8	.....	.....	2.5	3.75	7.0	11.5	5.1	5.9	2.05	1.0
7	1.0	.8	.....	.....	2.3	4.25	9.45	8.2	4.9	6.65	2.0	1.0
8	.9	.75	.....	.....	2.25	3.15	11.8	6.8	4.9	7.1	2.0	.9
9	.9	.7	.....	.....	2.45	3.0	11.7	6.05	5.8	7.4	1.85	.9
10	.9	.7	.....	.....	2.25	2.95	9.75	5.6	6.2	7.55	1.8	.9
11	.9	.8	.....	.....	1.8	2.7	7.5	5.3	6.7	7.45	1.8	.85
12	.85	.8	.....	.....	1.6	2.55	7.1	5.3	11.1	6.45	1.7	.8
13	.8	.8	.....	.....	2.45	3.25	7.25	5.15	12.45	5.7	1.6	.8
14	.8	.8	.....	− .4	3.1	6.8	7.45	5.15	12.65	5.2	1.55	.8
15	.9	.8	.....	− .4	4.3	10.6	7.55	5.2	11.5	4.95	1.45	.8
16	1.0	.85	.....	− .4	5.8	12.05	7.55	4.9	7.65	4.65	1.4	.8
17	1.0	.9	.....	− .4	5.9	12.25	7.35	4.55	6.0	4.35	1.4	.8
18	1.05	.9	.....	− .4	4.2	12.5	7.1	8.0	5.45	4.2	1.3	.8
19	1.1	1.05	.....	− .4	3.0	12.8	6.75	12.35	5.3	4.3	1.3	.8
20	1.45	1.3	.....	− .5	3.9	13.05	6.35	11.6	5.25	4.0	1.3	.8
21	2.15	1.55	.....	− .6	6.65	13.1	6.1	8.5	6.15	3.6	1.3	.8
22	2.4	1.7	.....	− .65	5.85	13.2	5.9	7.3	6.4	3.3	1.3	.8
23	2.15	1.8	.....	− .75	4.3	13.05	5.55	6.9	5.8	3.05	1.25	.8
24	1.85	1.8	.....	− .8	3.25	11.95	5.25	6.25	5.45	2.9	1.2	.8
25	1.6	1.9	.....	− .9	2.4	9.75	5.05	5.65	5.35	2.8	1.2	.8
26	1.4	1.75	.....	− .9	2.2	9.15	4.75	5.3	5.2	2.7	1.1	.8
27	1.25	1.65	.....	− .9	2.6	9.05	4.55	5.15	4.95	2.6	1.1	.7
28	1.15	1.6	.....	− .9	2.8	9.05	4.35	5.3	4.8	2.6	1.05	.7
29	1.1	.....	.....	− .9	2.55	9.15	4.6	5.6	4.65	2.6	1.0	.7
30	1.1	.....	.....	− .75	2.25	8.9	7.7	5.4	4.3	3.25	1.0	.7
31	1.05	.....	.....	.....	2.1	.....	8.35	5.2	.....	4.05	.....	.7
1904.												
1	.7	.2	.0	− .8	.0	1.3	2.8	2.95	.2	12.6	12.3	7.3
2	.7	.2	.0	− .65	.1	3.05	9.6	2.5	.1	12.6	12.2	7.2
3	.7	.2	.0	− .55	.0	4.7	10.7	2.1	.1	12.55	12.4	7.1
4	.7	.2	− .1	− .5	.0	5.2	7.4	1.75	.1	12.45	12.5	7.0
5	.7	.2	− .2	5.45	.7	4.25	5.8	1.55	.3	12.4	12.05	6.85
6	.7	.2	− .2	6.4	7.3	3.8	5.35	1.5	.55	12.25	11.85	6.7
7	.7	.2	− .25	5.2	6.5	3.75	4.7	1.45	.75	12.05	11.3	6.6
8	.7	.2	− .3	4.05	4.0	7.6	4.05	1.25	1.0	11.7	10.65	6.5
9	.7	.2	− .3	3.35	2.75	11.1	3.85	1.05	2.0	11.7	10.15	6.4
10	.7	.2	− .3	2.8	3.5	10.55	3.65	.95	9.25	11.15	9.95	6.4
11	.7	.2	− .35	2.25	6.7	7.5	3.3	.9	11.07	10.25	10.45	6.4
12	.7	.2	− .4	1.8	4.9	5.8	2.9	.9	12.35	10.25	10.1	6.85
13	.6	.2	− .4	1.35	3.7	5.35	2.65	1.15	12.5	10.1	9.55	7.0
14	.6	.25	− .5	.95	3.0	4.7	2.35	2.1	12.55	10.15	9.25	7.0
15	.6	.45	− .6	.7	5.7	4.4	2.15	2.95	12.7	10.4	8.9	7.0
16	.6	.65	− .6	.45	7.2	4.7	1.95	3.4	12.8	10.9	8.5	6.9
17	.6	.55	− .6	.25	7.9	4.9	1.75	2.9	12.8	11.5	8.3	6.8
18	.6	.25	− .6	.1	10.2	4.9	1.6	2.35	12.9	12.25	8.2	6.65
19	.5	.15	− .6	.0	9.3	4.6	1.45	1.8	12.9	12.4	8.1	6.45
20	.5	.0	− .6	− .1	6.6	4.0	1.3	1.45	13.0	12.5	8.0	6.3
21	.5	.0	− .6	− .15	5.05	3.4	1.2	1.4	13.0	12.5	7.9	6.2
22	.5	.0	− .6	− .25	4.15	3.2	1.1	1.25	13.0	12.5	7.75	6.2
23	.5	.0	− .7	− .3	3.55	3.45	1.0	.95	12.9	12.65	7.6	6.2
24	.4	.0	− .7	− .4	3.0	4.65	1.0	.65	12.9	12.75	7.45	6.3
25	.4	.05	− .7	− .4	2.6	4.8	.9	.5	12.8	12.8	7.25	6.4

[a] Gage heights for 1903 complete so far as Mexican records exist.

Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
26	0.4	0.2	−0.7	−0.3	2.2	3.9	0.9	0.5	12.8	12.7	7.1	6.3
27	.4	.2	− .7	− .2	1.85	3.25	4.25	.45	12.7	12.7	7.0	6.2
28	.4	.15	− .7	− .3	1.65	2.65	4.75	.4	12.7	12.6	7.0	6.1
29	.3	.0	− .7	− .2	1.45	2.35	4.65	.4	12.7	12.6	7.2	6.0
30	.3	.....	− .7	.0	1.25	2.15	4.15	.4	12.7	12.5	7.2	5.9
31	.2	.....	− .7	.....	1.1	.....	3.6	.3	.....	12.5	.....	5.65
1907.												
1	5.5	4.2	3.1	1.7	2.1	7.6	6.45	5.2	2.25	6.9	6.0	6.0
2	5.4	4.1	3.0	1.7	2.2	5.9	6.4	5.2	2.45	6.9	7.75	6.2
3	5.3	4.2	3.0	1.7	2.2	5.7	6.4	5.2	3.25	6.95	7.1	6.2
4	5.25	4.2	3.0	1.7	2.2	5.7	7.3	5.2	4.1	7.0	6.0	6.25
5	5.2	4.2	2.9	1.7	3.5	5.7	11.15	5.3	4.75	6.7	5.95	6.4
6	5.1	4.3	2.8	1.6	6.55	5.3	13.4	5.3	5.35	6.3	6.5	7.7
7	5.05	4.4	2.7	1.6	10.85	5.1	12.0	5.3	5.8	6.05	6.7	9.95
8	4.9	4.5	2.65	1.5	7.65	5.0	10.4	5.3	6.4	6.35	7.1	10.0
9	4.8	4.4	2.6	1.4	5.5	5.15	13.0	5.2	6.7	10.4	7.55	9.2
10	4.7	4.4	2.5	1.3	5.05	5.35	13.65	5.05	7.05	11.55	7.85	8.7
11	4.7	4.3	2.5	1.25	5.6	5.45	11.8	4.85	7.8	8.85	8.45	8.3
12	4.6	4.3	2.45	1.2	6.6	5.65	9.05	4.65	7.9	6.6	9.5	8.05
13	4.55	4.25	2.4	1.2	6.35	5.85	7.8	4.5	9.15	6.15	11.55	7.85
14	4.5	4.1	2.35	1.2	5.95	6.0	7.3	4.5	8.25	5.9	11.55	7.7
15	4.5	3.95	2.3	1.55	5.45	6.1	7.2	4.45	7.95	5.5	10.6	7.7
16	4.4	3.8	2.4	1.75	5.15	6.2	7.15	4.25	7.85	5.15	9.35	7.6
17	4.4	3.7	2.4	1.95	4.85	6.3	7.1	4.1	7.75	4.95	8.9	7.45
18	4.4	3.6	2.4	2.1	4.65	6.4	7.65	4.1	7.3	4.8	8.4	7.25
19	4.4	3.5	2.4	2.1	4.45	6.65	7.45	4.1	6.7	4.7	8.0	7.1
20	4.3	3.4	2.3	2.1	4.25	7.8	7.25	4.0	6.7	4.6	7.75	7.0
21	4.3	3.3	2.3	2.1	4.1	8.35	6.95	4.0	6.6	4.5	7.55	6.85
22	4.2	3.2	2.2	2.1	4.25	7.2	6.85	3.9	6.6	4.4	7.3	6.7
23	4.2	3.2	2.2	2.1	4.7	7.35	6.65	3.75	7.8	4.3	6.95	6.55
24	4.2	3.2	2.1	2.0	5.5	7.75	6.5	3.5	9.8	4.2	6.9	6.4
25	4.2	3.2	2.0	2.0	5.6	8.0	6.35	3.15	10.1	4.2	6.75	6.3
26	4.3	3.2	1.9	1.9	5.5	7.6	6.15	2.95	9.4	4.7	6.55	6.25
27	4.3	3.2	1.8	1.8	5.5	7.35	5.85	2.65	8.85	5.05	6.4	6.15
28	4.3	3.1	1.8	1.7	5.4	7.15	5.7	2.45	8.35	5.2	6.3	5.75
29	4.3	.....	1.7	1.6	12.0	7.05	5.6	2.3	7.65	5.3	6.2	5.6
30	4.3	.....	1.7	1.6	13.0	6.7	5.45	2.3	6.95	5.45	6.1	5.6
31	4.3	.....	1.7	.....	9.7	.....	5.25	2.25	.....	5.65	.....	5.55
1908.												
1	5.4	3.5	2.0	.85	4.4	5.1	3.55	5.4	8.0	5.35	3.3	2.0
2	5.3	3.3	2.0	.8	4.15	5.15	3.35	8.45	7.75	5.1	3.15	2.0
3	5.25	3.25	2.0	.8	3.95	5.5	3.2	7.65	8.15	4.9	2.95	2.0
4	5.2	3.1	1.9	.7	3.8	5.2	3.05	7.3	9.25	4.75	2.75	1.9
5	5.1	3.1	1.9	.7	3.75	4.75	2.8	6.95	9.2	4.55	2.7	1.9
6	5.1	3.0	1.85	.65	3.6	4.3	2.4	6.55	9.25	4.45	2.6	1.9
7	5.1	2.9	1.75	.6	3.55	4.0	2.15	5.5	10.85	4.2	2.5	2.1
8	5.0	2.85	1.7	.6	3.75	3.8	2.3	8.05	11.6	4.0	2.4	2.1
9	4.8	2.8	1.6	.5	4.1	3.8	3.45	10.9	11.7	3.85	2.4	2.0
10	4.7	2.8	1.55	.5	3.85	3.85	4.6	10.75	11.8	3.9	2.3	1.95
11	4.6	2.6	1.5	.5	3.75	4.0	5.1	10.85	12.1	6.1	2.2	1.9
12	4.5	2.6	1.4	.75	3.65	4.0	6.15	9.9	11.65	6.05	2.25	1.9
13	4.35	2.6	1.35	7.5	3.5	4.0	6.75	8.7	9.8	5.35	4.15	1.85
14	4.15	2.6	1.3	12.25	3.45	3.85	5.65	8.1	9.45	4.65	6.4	1.8
15	4.1	2.6	1.3	13.05	3.4	3.35	5.1	7.75	9.55	4.2	5.25	1.8
16	4.0	2.6	1.2	10.45	8.0	3.2	5.45	8.65	11.65	3.9	4.55	1.7
17	3.95	2.6	1.2	8.25	13.5	2.95	5.65	11.4	12.4	3.65	4.25	1.7
18	3.9	2.5	1.2	7.4	12.4	2.75	5.2	12.75	11.4	3.45	3.9	1.7
19	3.9	2.5	1.1	6.9	7.65	2.55	5.0	13.0	10.2	3.25	3.45	1.7
20	3.85	2.5	1.1	6.65	5.75	2.4	3.25	11.65	9.4	3.05	3.15	1.7
21	3.8	2.4	1.1	5.9	4.8	2.3	2.85	9.9	8.6	2.85	2.85	1.65
22	3.8	2.3	1.1	9.5	4.3	2.25	2.4	9.45	7.9	2.65	2.65	1.6
23	3.75	2.2	1.1	13.15	4.0	2.0	2.05	9.2	7.55	3.05	2.55	1.6
24	3.7	2.1	1.1	13.2	4.0	2.0	1.9	8.85	7.3	4.35	2.5	1.6
25	3.6	2.1	1.0	9.7	4.0	2.0	1.85	8.6	7.05	9.55	2.4	1.5
26	3.6	2.1	1.0	6.5	4.0	1.9	1.75	8.2	6.8	7.25	2.25	1.5
27	3.6	2.1	1.0	5.55	8.25	1.9	1.45	8.1	6.5	5.25	2.1	1.5
28	3.6	2.0	1.0	5.35	10.5	5.7	1.2	7.95	6.15	4.4	2.0	1.5
29	3.6	2.0	1.0	5.05	8.0	4.5	1.6	7.7	5.9	3.9	2.0	1.5
30	3.6	.....	.9	4.7	5.95	3.8	2.4	7.95	5.55	3.65	2.0	1.5
31	3.6	.....	.9	.....	5.0	.....	2.55	8.7	.....	3.4	.....	1.5

CONEJOS RIVER NEAR MOGOTE, COLO.

Conejos River, the most important tributary of the Rio Grande in Colorado, rises on the eastern slope of the San Juan Range, which forms the western boundary of Conejos County. It first flows southeastward, but at the town of Conejos bends northeastward and enters the Rio Grande below the mouth of Trinchera Creek.

The gaging station which was established March 21, 1907, replacing the station formerly maintained about 4 miles below, is located at a private highway bridge on Jacob's ranch, about 16 miles above Antonito, Colo., in T. 33 N., R. 6 E., New Mexico principal meridian. It is above every important diversion for irrigation, and below all the principal tributaries except the San Antonio.

The data obtained at this station show the amount of water available for irrigation.

Water taken from the Conejos by numerous ditches below the station is used to irrigate 70,000 to 80,000 acres of land. The basin above the station affords excellent opportunities for storage, none of which are utilized at the present time. It will be difficult to procure additional water rights for irrigation along this stream.

The river is covered with ice for three or four months during the winter season. The stream bed is strewn with cobblestones and bowlders, the water has a comparatively high velocity at all stages, and there are eddies around the crib piers of the bridge. The rating curve developed, however, is very good for low and medium stages.

The datum of the chain gage has not been changed since the station was established. This gage is at the same datum as the rod gage used by Mr. Antoine Jacob during 1905 and 1906. The gage heights for these years have been furnished the United States Geological Survey by him from his private records.

Discharge measurements of Conejos River near Mogote, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 21	R. I. Meeker	95	178	1.38	374
April 22	do	95	183	1.50	402
May 13	W. B. Freeman	92	228	1.77	573
June 11	do	127	376	2.77	1,990
June 27	do	127	416	3.07	2,310
July 30	do	108	250	1.88	775
August 29	C. L. Chatfield	92	174	1.22	280
October 2	J. B. Stewart	100	133	.79	134
November 8	W. B. Freeman	84.5	102	.50	83
1908.					
March 27	J. B. Stewart	86	126	.75	138
May 18	W. B. Freeman	112	259	2.03	709
June 9	J. B. Stewart	122	339	2.54	1,200
July 11	do	98	207	1.52	423
December 1	do	45	49	.70	[a] 52
December 6	do	39.5	49	.82	[a] 67

[a] Measurement made by wading downstream from bridge. Ice conditions at gage.

Daily gage height, in feet, of Conejos River near Mogote, Colo., for 1905 to 1908.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1905.							1905.						
1		3.4	1.95	1.4	0.6	0.5	16	2.6	3.4	1.25	0.7	0.5	
2		3.6	1.8	1.3	.6	.5	17	2.7	3.0	1.2	.6	.5	
3		3.85	1.65	1.3	.6	.5	18	2.9	2.9	1.3	.6	.5	
4	1.9	4.0	1.7	1.5	.6	.5	19	3.0	2.8	1.3	.6	.4	
5	1.7	4.25		1.45	.6		20	3.0	2.6	1.5	.6		
6	1.55	3.75	1.55	1.25	.6		21	3.15	2.5	1.35	.5		
7	1.6	3.6	1.45	1.5	.6		22	3.25	2.4	1.25	.5		
8	1.8	3.75	1.4	1.4	.65		23	3.25	2.45	1.2	.6		
9	1.9	3.65	1.35	1.25	.65		24	3.35	2.35	1.15	.6		
10	1.8	3.4	1.4	1.25	.65		25	3.4	2.5	1.05	.6		
11	1.7	3.5	1.35	1.2	.6		26	3.35	2.3	1.0	.7		
12	1.7	3.3	1.3	1.0	.55		27	3.35	2.3	1.0	.6		
13	1.9	3.25	1.25	.8	.5		28	3.15	2.2	1.15	.6		
14	2.0	3.2	1.5	.7	.5		29	3.0	2.15	1.0	.7		
15	2.2	3.25	1.25	.7	.45		30	3.0	2.05	1.2	.7	.55	
							31	3.2		1.15	.6		

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1906.				1906.			
1		1.45	2.55	16		2.7	3.65
2		1.4	2.75	17		2.8	3.55
3		1.4	2.6	18		2.85	3.4
4		1.85		19		3.0	3.25
5		1.95	2.75	20		2.95	3.15
6			3.25	21		3.3	3.0
7		2.0	3.5	22	1.8	3.25	
8		2.4	3.4	23	1.9	3.15	
9		2.5	3.4	24	1.9	2.85	
10		2.75	3.5	25	1.85		
11		2.8	3.7	26	1.75	2.45	
12		2.65	3.7	27	1.75	2.45	
13		2.5	3.75	28	1.75	2.75	
14		2.55	3.6	29	1.45	2.65	
15		2.55	3.65	30	1.4	2.5	
				31		2.45	

Daily gage height, in feet, of Conejos River near Mogote, Colo., for 1905 to 1908—Con.

[Francisque Jacob, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	1.0	1.55	2.0	3.45	1.95	1.55	0.6	0.5	0.5
2	.....	1.0	1.4	2.15	3.4	1.9	1.5	.6	.5	.5
3	.....	1.0	1.4	2.45	3.25	1.85	1.4	.6	.5	.6
4	.....	1.05	1.4	2.7	3.1	1.8	1.3	.7	.5	.6
5	.....	1.05	1.4	2.9	3.1	1.8	1.2	.7	.5	.5
6	.....	1.1	1.4	3.0	3.0	1.7	1.2	.75	.5	.5
7	.....	1.1	1.4	3.0	3.2	1.75	1.2	.8	.5	.5
8	.....	1.2	1.4	2.95	3.0	1.6	1.2	.7	.5	.6
9	.....	1.3	1.4	2.75	2.9	1.6	1.3	.7	.5	.6
10	.....	1.5	1.45	2.7	2.95	1.55	1.2	.7	.5	.6
11	.....	1.8	1.65	2.9	2.8	1.45	1.2	.7	.5	.7
12	.....	2.0	1.9	3.0	2.7	1.4	1.05	.6	.5	.7
13	.....	2.1	1.75	3.1	2.75	1.8	.95	.6	.5	.7
14	.....	2.15	1.65	3.1	3.25	1.55	.9	.6	.4	.7
15	.....	2.2	1.6	3.2	3.25	1.45	.9	.6	.4	.7
16	.....	2.15	1.75	3.15	2.7	1.4	.9	.6	.4	.7
17	.....	2.0	2.05	3.0	2.45	1.3	.9	.6	.5	.7
18	.....	2.0	2.2	3.0	2.35	1.3	.9	.6	.5	.7
19	.....	2.0	2.45	3.0	2.35	1.3	1.0	.6	.5	.7
20	.....	2.0	2.8	2.85	2.3	1.3	1.0	.6	.5	.7
21	1.4	2.0	3.0	2.7	2.4	1.4	.9	.6	.5	.7
22	1.5	1.55	3.05	2.7	2.3	1.4	.9	.5	.5	.7
23	1.25	1.5	3.05	2.7	2.25	1.3	.8	.5	.5	.7
24	1.2	1.45	2.75	2.9	2.25	1.2	.8	.5	.5	.7
25	1.2	1.5	2.5	2.95	2.35	1.3	.8	.6	.5	.7
26	1.2	1.5	2.5	3.05	2.15	1.3	.8	.6	.5	.7
27	1.1	1.5	2.45	3.05	2.15	1.2	.7	.6	.5	.7
28	1.05	1.5	2.4	3.15	1.95	1.2	.7	.6	.5	.7
29	1.0	1.6	2.25	3.25	1.95	1.2	.7	.6	.6	.7
30	1.0	1.6	2.1	3.25	2.0	2.0	.6	.6	.6	.7
31	1.0	.....	2.05	.....	1.9	1.75	.....	.6	.....	.7
1908.										
1	.....	.55	1.4	2.05	2.0	1.35	.9	.7	.5	.7
2	.....	.6	1.65	2.2	1.85	1.6	.8	.7	.5	.....
3	.....	.65	1.75	2.35	1.85	1.5	.85	.7	.5	.....
4	.....	.75	1.5	2.35	1.8	1.35	.7	.7	.5	.....
5	.....	.75	1.8	2.4	1.7	1.25	.7	.6	.5	.....
6	.....	.75	1.7	2.4	1.75	1.15	.7	.6	.5	.....
7	.....	.75	1.3	2.25	1.7	1.1	.6	.6	.5	.....
8	.....	.75	1.55	2.15	1.8	1.15	.6	.6	.5	.....
9	.....	.75	1.65	2.55	1.6	1.1	.6	.6	.5	.....
10	.....	.75	1.5	2.75	1.5	1.1	.6	.6	.5	.....
11	.....	.75	1.55	2.9	1.5	1.15	.5	.6	.5	.....
12	.....	.75	1.65	2.75	1.7	1.1	.5	.6	.5	.....
13	.....	.8	1.4	2.75	1.6	1.0	.5	.6	.5	.....
14	.....	.95	1.3	2.8	1.55	1.15	.6	.6	.5	.....
15	0.8	1.1	1.4	2.8	1.6	1.25	.6	.6	.5	.....
16	.8	1.25	1.7	2.85	1.6	1.2	.6	.5	.5	.....
17	.8	1.2	1.9	2.75	1.65	1.7	.6	.55	.5	.....
18	.85	1.25	2.05	2.4	1.5	1.35	.5	.6	.5	.....
19	.8	1.25	2.2	2.2	1.45	1.4	.5	.6	.5	.....
20	.8	1.15	2.2	2.25	1.4	1.4	.5	.6	.5	.....
21	.8	1.25	2.0	2.25	1.35	1.5	.5	.7	.5	.....
22	.75	1.45	2.1	2.25	1.3	1.45	.5	.7	.5	.....
23	.7	1.5	1.95	2.25	1.55	1.4	.5	.7	.6	.....
24	.75	1.35	1.8	2.25	1.5	1.2	.5	.7	.6	.....
25	.75	1.3	1.8	2.25	1.55	1.15	1.2	.7	.6	.....
26	.75	1.25	1.9	2.5	1.2	1.1	1.0	.6	.6	.....
27	.75	1.2	1.8	2.5	1.15	1.05	.9	.5	.6	.....
28	.65	1.15	1.75	2.4	1.15	1.0	.8	.5	.6	.....
29	.55	1.25	1.85	2.2	1.1	1.0	.8	.5	.6	.....
30	.55	1.3	1.95	2.05	1.2	1.0	.7	.5	.6	.....
31	.55	.....	2.1	.....	1.3	.9	.....	.5	.....	.....

NOTE.—Ice conditions begin November 23, 1908. On December 1, 1908, there was 0.9 foot of ice at gage.

Rating table for Conejos River near Mogote, Colo., for 1905 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	68	1.30	308	2.20	900	3.20	2,330
.50	83	1.40	353	2.30	1,000	3.40	2,680
.60	101	1.50	403	2.40	1,110	3.60	3,030
.70	122	1.60	458	2.50	1,230	3.80	3,380
.80	146	1.70	518	2.60	1,360	4.00	3,730
.90	172	1.80	583	2.70	1,500	4.20	4,080
1.00	200	1.90	653	2.80	1,650		
1.10	232	2.00	728	2.90	1,810		
1.20	268	2.10	810	3.00	1,980		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907 to 1908 and two measurements made in the first part of 1909 and is well defined between gage heights 0.4 foot and 2.5 feet. Above gage height 2.5 feet the curve is only approximate.

Monthly discharge of Conejos River near Mogote, Colo., for 1905 to 1908.

[Drainage area, 282 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1905.							
May 4–31	2,680	430	1,500	5.32	5.54	83,300	A.
June	4,170	769	2,160	7.66	8.55	129,000	A.
July	690	200	339	1.20	1.38	20,800	A.
August	403	83	190	.674	.78	11,700	A.
September	112	68	87.8	.311	.35	5,220	C.
The period						250,000	
1906.							
April 22–30	653	353	543	1.93	.65	9,690	A.
May	2,500	353	1,340	4.75	5.48	82,400	A.
June 1–21	3,290	1,300	2,480	8.79	6.86	103,300	B.
The period						195,000	
1907.							
March 21–31	403	200	263	.933	.38	5,740	A.
April	900	200	486	1.72	1.92	28,900	A.
May	2,070	353	848	3.01	3.47	52,100	A.
June	2,590	728	1,830	6.49	7.24	109,000	A.
July	2,770	653	1,520	5.39	6.21	93,500	A.
August	728	268	427	1.51	1.74	26,300	A.
September	430	101	216	.766	.85	12,900	B.
October	146	83	106	.376	.43	6,520	C.
November	101	68	82.7	.293	.33	4,920	D.
December	122	83	112	.397	.46	6,890	C.
The period						347,000	
1908.							
March 15–31	159	92	130	.461	.29	4,380	C.
April	403	92	219	.777	.87	13,000	B.
May	900	308	564	2.00	2.31	34,700	A.
June	1,810	769	1,170	4.15	4.63	69,600	A.
July	728	232	432	1.53	1.76	26,600	A.
August	518	172	288	1.02	1.18	17,700	A.
September	268	83	118	.418	.47	7,020	C.
October	122	83	103	.365	.42	6,330	C.
November	83	80	82.2	.191	.21	4,890	D.
The period						184,000	

NOTE.—Discharge estimated November 23–30, 1908. Values of accuracy for 1905 and 1906 are based on the assumption that the stream bed remained permanent.

SANTA FE CREEK AT SANTA FE, N. MEX.

Santa Fe Creek rises on the range east of Santa Fe and flows westward over high plains to join the Rio Grande south of the Espanola Valley.

The gaging station, which was established May 31, 1907, to determine the amount of water available for irrigation and storage, is located at the Don Gaspar Avenue Bridge in the city of Santa Fe.

No important tributaries except intermittent streams enter below the station. The drainage area at the station is about 40 square miles, and at the mouth of the river it is about 300 square miles.

The reservoir for the Santa Fe municipal supply is situated in the canyon above the station, and a water-power plant of 100-horsepower capacity is used to develop power for lighting. Very little water is diverted for irrigation above the station. One small ditch takes water out just above. In the canyon 8 miles above Santa Fe is a reservoir site where 10,000 acre-feet can be stored.

Ice is usually to be found in the stream during the winter months, though the flow is very small during that period. The low-water flow is regulated to some extent by the waterworks reservoir above.

The gage datum was changed on August 13, 1908, and again on August 22, 1908. Results obtained at this station have been very unsatisfactory owing to the torrential character of the stream, the shifting nature of the bed, and the inadequate number of discharge measurements.

Discharge measurements of Santa Fe Creek at Santa Fe, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 31	V. L. Sullivan	12	9.5	0.50	19.5
June 25	do	7	1.8	.17	2.7
1908.					
May 23	C. D. Miller			.48	11.8
July 18	Cooper and Miller	12	10.0	.55	34.6
Do	do	11.5	7.2	.50	24.5
Aug. 17	R. L. Cooper	16	19	.20	95
Aug. 19	do	13	11	−.10	33
Do	do	13	12	.05	38
Aug. 20	do	13	13	.00	52
Aug. 21	do	12.5	9.4	−.15	30
Nov. 24	W. B. Freeman	2	.5	−.40	.4

NOTE.—Measurements in 1908 were made by wading.

Daily gage height, in feet, of Santa Fe Creek at Santa Fe, N. Mex., for 1907 and 1908.

[V. L. Sullivan, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.								1907.							
1	0.49	0.00	0.00	0.60	0.00	0.05	0.20	16	0.44	0.00	0.00	0.10	0.00	0.05	0.30
2	.50	.00	.00	.50	.00	.05	.30	17	.44	.00	.00	.00	.00	.05	.30
3	.50	.00	.20	.55	.00	.05	.10	18	.39	.00	.00	.05	.00	.05	.30
4	.50	.00	.10	.50	.00	.05	.08	19	.45	.00	.05	.00	.00	.06	.35
5	.50	.00	.15	.40	.00	.05	.10	20	.50	.00	.10	.05	.00	.06	.35
6	.50	.00	.00	.50	.00	.08	.15	21	.40	.00	.00	.02	.05	.05	.30
7	.52	.00	.00	.40	.00	.08	.20	22	.40	.00	.00	.02	.00	.05	.25
8	.52	.00	.00	.35	.00	.08	.20	23	.35	.00	.00	.00	.00	.10	.30
9	.50	.05	.00	.42	.00	.08	.20	24	.35	.00	.00	.00	.00	.15	.25
10	.50	.00	.00	.40	.00	.06	.25	25	.28	.00	.00	.00	.00	.15	.25
11	.48	.05	.00	.30	.00	.06	.20	26	.20	.00	.00	.00	.00	.15	.25
12	.48	.00	.00	.10	.00	.05	.20	27	.15	.00	.00	.00	.00	.18	.20
13	.45	.00	.00	.00	.00	.05	.30	28	.15	.05	.00	.00	.00	.18	.20
14	.45	.00	.00	.00	.00	.05	.30	29	.10	.05	.00	.00	.02	.20	.25
15	.40	.00	.00	.00	.00	.08	.35	30	.05	.00	.80	.00	.02	.20	.20
								31	.....	.00	.60	.....	.02	.....	.25

[Avis Brumback and C. D. Miller, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	0.3	0.1	0.1	.....	0.05	0.4	0.0	0.4	−0.2	−0.4	−0.4	−0.2
2	.35	.1	.2	.....	.0	.6	.0	.7	− .3	− .4	− .4	− .2
3	.3	.15	.15	.....	.1	.3	.0	.5	− .4	− .4	− .5	− .2
4	.25	.1	.15	.....	.25	.2	.0	.4	− .4	− .4	− .4	− .4
5	.3	.1	.2	.....	.0	.25	.0	.3	− .4	− .4	− .4	− .4
6	.3	.3	.3	.....	.0	.2	.0	.25	− .4	− .4	− .4	− .4
7	.3	.3	.2	.....	.2	.15	.0	.3	− .4	− .4	− .4	− .5
8	.3	.25	.05	.....	.0	.15	.0	.4	− .5	− .4	− .5	− .5
9	.3	.2	.25	.....	.0	.15	.0	.2	.....	− .4	− .4	− .5
10	.25	.2	.05	.....	.0	.0	.0	.2	.....	− .4	− .4	− .5
11	.25	.2	.25	.....	.0	.4	.0	.25	.....	− .4	− .4	− .5
12	.25	.2	.1	.....	.1	.3	.0	.25	.....	− .4	− .4	− .5
13	.2	.2	.2	.....	.2	.25	.0	1.5	.....	− .4	− .4	− .5
14	.25	.2	.15	.....	.15	.0	.0	1.5	.....	− .4	− .4	− .5
15	.25	.25	.0	.....	.0	.0	1.0	.95	.....	− .4	− .4	− .5
16	.2	.25	.05	.....	.0	.3	.3	.....	.....	− .4	− .4	− .5
17	.2	.1	.1	.....	.15	.25	.3	.5	.....	− .4	− .4	− .5
18	.25	.2	.05	.....	.15	.0	2.0	.2	.....	− .4	− .4	− .5
19	.25	.2	.0	.....	.1	.0	.3	− .1	.....	− .4	− .4	− .4
20	.2	.15	.0	.....	.0	.0	.3	.0	.....	− .4	− .4	− .3
21	.2	.2	.0	.....	.0	.0	.4	.35	.....	− .3	− .4	− .3
22	.2	.25	.0	0.05	.35	.0	.2	.3	.....	.0	− .4	− .3
23	.25	.2	.0	.05	.55	.0	.3	.38	.....	− .1	− .4	− .3
24	.2	.2	.0	.05	.4	.0	.25	.38	.....	− .3	− .3	− .4
25	.2	.25	.0	.05	.3	.0	.3	.3	.....	− .3	− .3	− .4
26	.1	.2	.0	.1	.15	.0	.2	.1	.....	− .2	− .3	− .4
27	.1	.3	.0	.15	.1	.1	.2	.0	.....	− .2	− .3	− .4
28	.2	.2	.0	.2	.15	.0	.2	.0	.....	− .3	− .2	− .6
29	.2	.25	.0	.0	.15	.0	.1	− .2	.....	− .2	− .2	− .5
30	.2	.....	.0	.0	.0	.0	.2	− .1	.....	− .3	− .2	− .5
31	.2	.....	.0	.....	.0	.....	.35	− .1	.....	− .35	.....	− .3

NOTE.—April 1–21, 1908, no flow. All water diverted above gage for irrigation. Water standing in pools June 30–July 14, 1908. Gage heights beginning August 13, 1908, refer to new gage. August 21, old gage read 0.3 foot. September 9–30 no readings were made but a little water was flowing below the gage.

MIMBRES RIVER NEAR FAYWOOD, N. MEX.

The station, which was established April 23, 1908, is located about 6 miles southeast of Faywood Hot Springs and 10 miles from Faywood station on the Silver City branch of the Santa Fe Railway. The gage is located about 400 feet below the proposed Rio Mimbres reservoir dam site.

The data obtained here will show the amount of water available for storage. No important tributaries enter in the vicinity of the station, though numerous intermittent tributaries come in both above and below. The drainage area is about 450 square miles.

Some water is used for irrigation in the Mimbres Valley below the station, but as this is primarily a flood stream, and as storage has not been provided, such irrigation is uncertain. By storing the flood water and cutting off the underflow at the Rio Mimbres dam site, it will be possible to reclaim several thousand acres of land along this stream.

The flow of the stream at the gaging station is not usually affected by ice during the winter months. As the channel is very shifting in character, frequent measurements are necessary at high and medium stages to obtain the best results.

The datum of the gage has not been changed during the maintenance of the station. The present chain gage was installed on July 31, 1908.

Discharge measurements of Mimbres River near Faywood, N. Mex., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	R. L. Cooper	18	5.4	0.00	6.3
July 31	do	60	21	.20	38

Daily gage height, in feet, of Mimbres River near Faywood, N. Mex., for 1908.

[Ralph C. Trujillo, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.1	0.1	0.0	0.2	0.2	0.2	0.1	−0.1
2	.1	.1	.0	.6	.2	.2	.0	− .1
3	.2	.1	.0	.5	1.5	.3	.0	− .1
4	.2	.1	.0	.3	.5	.3	.0	.0
5	.1	.0	.0	.2	.2	.2	.0	.0
6	.1	.0	.0	.1	.2	.3	.0	.0
7	.1	.0	.0	.2	.2	.3	.0	.0
8	.1	.0	.0	.2	.2	.3	.0	.0
9	.1	.0	.1	.2	.2	.2	− .1	.0
10	.1	.0	.2	.2	.2	.3	− .1	.0
11	.1	.0	.2	.2	.2	.3	− .1	.0
12	.0	.0	.1	.1	.2	.3	− .1	.0
13	.0	.0	.0	.1	.2	.3	− .2	.1
14	.0	.0	1.1	.1	.2	.3	− .2	.2
15	.0	.0	.2	.8	.2	.3	− .1	.2
16	.0	.0	.4	.5	.2	.2	.0	.3
17	.0	.0	1.3	.3	.3	.2	.0	.2
18	.0	.0	.3	.2	.3	.2	− .1	.2
19	.0	.0	.3	.2	.2	.2	− .1	.2
20	.1	.0	.3	1.1	.3	.2	.0	.1
21	.1	.0	.2	.4	.2	.2	.0	.1
22	.1	.0	.1	.2	.3	.2	.0	.1
23	.1	.0	.0	.2	.2	.2	.0	.1
24	.1	.0	.0	.2	.2	.2	− .1	.1
25	.1	.0	1.5	.2	.2	.3	− .1	.2
26	.0	.0	1.1	.3	.3	.3	− .1	.2
27	.0	.0	1.7	2.3	.3	.3	− .1	.2
28	.0	.0	1.5	.3	.2	.2	− .1	.1
29	.0	.0	1.3	.2	.2	.2	− .1	.1
30	.0	.0	.5	2.5	.2	.2	− .1	.1
31	.0	.....	.2	.3	.....	.1	.....	.1

NOTE.—It is doubtful from the observer's records whether gage heights November 9–December 6 are plus or minus readings.

CAMERON CREEK AT FORT BAYARD, N. MEX.

This station, which was established on January 17, 1907, at the request of the United States Forest Service, to obtain data concerning flood run-off, is located near the pumping station at Fort Bayard, N. Mex., a United States Army post. The gage is a short distance above the crest of an old masonry dam, which was used to check the underflow of the creek.

For the greater part of the year the flow comes from springs, and amounts to less than 1 second-foot. Stephens Creek enters about 2 miles above this station.

The intake for the water supply of the post is above the station, and a little water is also diverted above for garden irrigation. The flood waters of this stream can probably be stored in natural depressions in the vicinity, which will make excellent reservoir sites. These can be supplied by feeder canals.

Ice conditions do not appreciably effect the flow of the stream at this point. The channel has filled up with sediment above the dam, which probably has some effect on low-water measurements. The channel is probably permanent for measurements taken at higher

stages. Unfortunately no high-water measurements have yet been made. The estimates of discharge given below are largely estimated.

No change has been made in the datum of the gage during the maintenance of the station. Gage observations have been taken gratis by Sergt. T. J. McBurney, U. S. Army.

Discharge measurements of Cameron Creek at Fort Bayard, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 19	W. A. Lamb	8	3.4	2.02	[a]14.0
May 14	do	2.5	.6	1.75	[b]1.0
1908.					
November 9	R. L. Cooper			1.45	[c].5

[a] Made by wading 300 feet above gage. [b] Made by floats near gage. [c] Estimated.

Daily gage height, in feet, and discharge, in second-feet, of Cameron Creek at Fort Bayard, N. Mex., for 1907 and 1908.

[Sergt. T. J. McBurney, observer.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.			1908.		
January 19	2.02	14.0	January 1–February 3		0.5
January 20–24		2.0	February 4		1.0
January 25–29		1.0	February 5–July 28		.5
January 30–31		2.0	July 29	2.1	18.0
February 1		1.5	July 30–August 19		.5
February 2–June 30		1.0	August 20	2.65	48.5
July 1–10		.5	August 21–December 31		.5
July 11		2.5			
July 12–20		.5			
July 21	2.2	23.5			
July 22–August 26		.5			
August 27	2.25	26.5			
August 28	2.35	32.0			
August 29–December 31		.5			

NOTE.—The gage heights for low stages are not a true index of the discharge and hence are not given. Discharges above 2.0 second-feet are estimated and are very approximate.

Monthly discharge of Cameron Creek at Fort Bayard, N. Mex., for 1907 and 1908.

Month.	Mean discharge in second-feet.	Run-off (total in acre-feet).	Month.	Mean discharge in second-feet.	Run-off (total in acre-feet).
1907.			1908.		
January 19–31	2.54	65.5	January	0.50	30.7
February	1.02	56.6	February	.52	29.9
March	1.00	61.5	March	.50	30.7
April	1.00	59.5	April	.50	29.8
May	1.00	61.5	May	.50	30.7
June	1.00	59.5	June	.50	29.8
July	1.31	80.6	July	1.06	65.2
August	2.35	144	August	2.05	126
September	.50	29.8	September	.50	29.8
October	.50	30.7	October	.50	30.7
November	.50	29.8	November	.50	29.8
December	.50	30.7	December	.50	30.7
The period		710	The year	.68	494

NOTE.—Monthly discharge, 1907 and 1908, approximate.

STEPHENS CREEK NEAR FORT BAYARD, N. MEX.

This station, which was established January 17, 1907, at the request of the United States Forest Service, is located one-fourth mile above the Fort Bayard planting station of the Forest Service, 3 miles north of Fort Bayard.

The records furnish valuable information concerning normal and flood run-off. The station is situated about 2 miles above the junction of this stream with Cameron Creek.

The normal flow of this creek is very small, but for short periods during floods it occasionally carries a large flow, which can probably be stored. The intake for the water supply of the planting station is above the gage.

The records of this station are little, if any, affected by ice. The results obtained have not been very satisfactory, owing to the small number of discharge measurements, none of which were taken when there was any considerable flow in the stream.

No change has been made in the datum of the gage since the establishment of the station.

Discharge measurements of Stephens Creek near Fort Bayard, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 17	W. A. Lamb	3	0.9	1.30	2.7
May 14	do	1	.1	1.14	[a].1

[a] Made by floats below gage.

Daily gage height, in feet, of Stephens Creek near Fort Bayard, N. Mex., for 1907 and 1908.

[E. F. Hadley and Amos Hedricks, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	.....	1.18	1.17	.....	1.14	1.18	.....	1.15	1.16	1.15	1.18	1.19
2	.....	1.18	1.16	.....	1.14	1.18	.....	1.14	1.15	1.14	1.17	1.19
3	.....	1.18	1.15	1.17	1.14	1.17	.....	1.14	1.16	1.14	1.17	1.19
4	.....	1.18	1.15	1.16	1.14	1.18	.....	1.15	1.14	1.15	1.17	1.18
5	.....	1.17	1.15	1.17	1.14	1.18	.....	1.15	1.15	1.15	1.16	1.20
6	.....	1.17	1.15	1.17	1.14	1.18	1.18	1.14	1.15	1.15	1.17	1.19
7	.....	1.17	1.16	1.17	1.15	1.18	1.18	1.15	1.14	1.15	1.17	1.18
8	.....	1.17	1.17	1.28	1.14	1.18	1.18	1.14	1.14	1.16	1.19	1.17
9	.....	1.17	1.17	1.14	1.14	1.18	1.18	1.13	1.12	1.16	1.17	1.17
10	.....	1.18	1.15	1.14	1.14	1.17	1.20	1.13	1.13	1.16	1.17	1.16
11	.....	1.18	1.16	1.13	1.14	1.17	1.19	1.12	1.13	1.17	1.18	1.17
12	.....	1.18	1.16	1.14	1.14	1.16	1.18	1.13	1.13	1.17	1.17	1.18
13	.....	1.18	1.16	1.14	1.14	1.16	1.19	1.14	1.13	1.17	1.17	1.18
14	.....	1.17	1.16	1.14	1.15	1.17	1.18	1.15	1.18	1.16	1.17	1.18
15	.....	1.17	1.16	1.14	1.15	1.15	1.18	1.14	1.15	1.16	1.16	1.18
16	.....	1.18	1.16	1.14	1.15	1.20	1.19	1.13	1.16	1.16	1.16	1.17
17	1.30	1.18	1.16	1.14	1.15	1.18	1.16	1.14	1.15	1.17	1.17	1.16
18	.....	1.17	1.16	1.14	1.15	1.17	1.16	1.14	1.16	1.19	1.17	1.16
19	.....	1.17	1.16	1.13	1.15	1.19	1.18	1.15	1.16	1.19	1.18	1.16
20	1.18	1.16	1.16	1.13	1.15	1.18	1.18	1.19	1.17	1.18	1.18	1.17
21	1.18	1.16	1.16	1.13	1.14	1.18	1.30	1.16	1.17	1.17	1.17	1.16
22	1.17	1.16	1.17	1.14	1.15	1.18	1.28	1.17	1.17	1.17	1.17	1.16
23	1.17	1.17	.....	1.14	1.15	1.18	1.17	1.17	1.16	1.16	1.17	1.17
24	1.17	1.17	.....	1.14	1.15	1.17	1.15	1.16	1.16	1.17	1.17	1.17
25	1.17	1.17	1.16	1.14	1.15	1.18	1.15	1.16	1.15	1.17	1.17	1.16
26	1.17	1.17	1.16	1.14	.....	1.12	1.14	1.17	1.15	1.16	1.18	1.16
27	1.17	1.18	1.16	1.14	.....	1.13	1.15	1.62	1.14	1.16	1.17	1.16
28	1.17	1.17	1.16	1.14	1.16	1.13	1.13	1.19	1.14	1.16	1.16	1.16
29	1.17	.....	.....	1.15	1.16	1.16	1.12	1.18	1.15	1.16	1.17	1.16
30	1.19	.....	.....	1.14	1.20	.....	1.13	1.17	1.14	1.17	1.18	1.17
31	1.18	.....	.....	.....	1.19	.....	1.14	1.16	.....	1.19	.....	1.16
1908.[b]												
1	1.17	1.17	1.16	1.15	1.15	1.13	.00	1.13	1.15	.....	.....	.....
2	1.17	1.17	1.16	1.14	1.15	1.13	.00	1.13	1.15	.....	.....	.....
3	1.19	1.17	1.16	1.17	1.17	1.13	.00	1.13	1.19	.....	.....	.....
4	1.18	1.18	1.17	1.16	1.17	1.13	.00	1.13	1.17	.....	.....	.....
5	1.18	1.18	1.16	1.15	1.16	1.13	.00	1.13	1.17	.....	.....	.....
6	1.18	1.17	1.16	1.14	1.16	1.13	.00	1.14	.....	.....	.....	.....
7	1.18	1.17	1.17	1.15	1.16	1.13	.00	1.14	.....	.....	.....	.....
8	1.18	1.18	1.17	1.15	1.16	1.12	.00	1.14	.....	.....	.....	.....
9	1.18	1.18	1.17	1.16	1.16	1.12	.00	1.14	.....	.....	.....	.....
10	1.18	1.18	1.17	1.15	1.16	1.12	.00	1.14	.....	.....	.....	.....
11	1.18	1.18	1.17	1.15	1.16	1.12	.00	1.14	.....	.....	.....	.....
12	1.18	1.18	1.17	1.15	1.14	1.12	.00	1.14	.....	.....	.....	.....
13	1.18	1.16	1.16	1.14	1.16	1.13	.00	1.14	.....	.....	.....	.....
14	1.17	1.18	1.16	1.14	1.16	1.12	.00	1.15	.....	.....	.....	.....
15	1.17	1.19	1.16	1.14	1.15	1.12	1.12	1.15	.....	.....	.....	.....
16	1.18	1.18	1.16	1.16	1.16	1.12	1.32	1.15	.....	.....	.....	.....
17	1.18	1.16	1.16	1.16	1.16	1.12	1.13	1.15	.....	.....	.....	.....
18	1.17	1.16	1.16	1.16	1.16	1.12	1.13	1.15	.....	.....	.....	.....
19	1.17	1.16	1.16	1.16	1.15	1.12	1.13	1.15	.....	.....	.....	.....
20	1.17	1.16	1.17	1.15	1.16	1.12	1.13	1.26	.....	.....	.....	.....
21	1.17	1.16	1.17	1.15	1.16	1.12	1.13	1.25	.....	.....	.....	.....
22	1.17	1.18	1.16	1.15	1.16	1.11	1.13	1.24	.....	.....	.....	.....
23	1.17	1.18	1.16	1.17	1.17	1.11	1.13	1.24	.....	.....	.....	.....
24	1.17	1.18	1.16	1.16	1.16	1.11	1.13	1.24	.....	.....	.....	.....
25	1.18	1.17	1.16	1.15	1.17	1.11	1.13	1.23	.....	.....	.....	.....
26	1.18	1.17	1.16	1.16	1.16	1.11	1.13	1.14	.....	.....	.....	.....
27	1.18	1.17	1.17	1.16	1.16	1.11	1.13	1.14	.....	.....	.....	.....
28	1.17	1.16	1.17	1.15	1.15	1.11	1.13	1.13	.....	.....	.....	.....
29	1.17	1.16	1.16	1.15	1.16	1.11	1.15	1.13	.....	.....	.....	.....
30	1.17	.....	1.16	1.15	1.16	1.11	1.13	1.13	.....	.....	.....	.....
31	1.17	.....	1.16	.....	1.15	.....	1.13	1.13	.....	.....	.....	.....

[a] Practically dry June 30–July 5, 1907.
[b] During May and June, 1908, part of the flow was diverted for purposes of irrigation.

PECOS RIVER DRAINAGE BASIN.

DESCRIPTION.

Pecos River, the largest tributary of the Rio Grande, rises on the east side of the Santa Fe Range in northern New Mexico, flows south through eastern New Mexico, then southeast through southwestern Texas, and unites with the Rio Grande about 400 miles (by river) below El Paso. Except for some of the upper tributaries, the branches of the Pecos are intermittent, carrying large floods at times. From source to mouth the river is about 800 miles long, and the total drainage area includes more than 32,000 square miles, of which 23,000 are in New Mexico and 9,000 in Texas.

The upper Pecos flows as a typical mountain stream through narrow valleys and deeply cut gorges, but below Fort Sumner the canyon-like walls disappear and are replaced by low rolling hills, and when the river reaches Roswell the gradation from the flood plains to the prairie is imperceptible. Arroyos and gulches are rare and canyons are practically unknown. The mountain tributaries of the upper Pecos rise at an elevation of about 11,000 feet; at Santa Rosa, N. Mex., the elevation is 4,600 feet; at Roswell, 3,500 feet; at Pecos, Tex., 2,550 feet, and at the mouth of the stream it is 1,000 feet.

The main Pecos may be said to be formed by the junction of the Gallinas with the upper Pecos at La Junta, N. Mex. The most important tributaries below this point and above Roswell are the Agua Negra and the Agua Negra Chiquita, which enter just above Puerto de Luna. Except for small springs no important tributaries enter along this stretch, but some of the dry gulches and arroyos occasionally carry large quantities of flood water. Among the most important of the lower tributaries are the Hondo, Rio Felix, the Penasco, Seven Rivers, and Black River.

It is rather a striking fact that the Pecos receives practically no tributaries from the east, probably because of the pervious character of the soil of the Staked Plains, upon which there is no surface drainage system. The water sinks into limestone rocks and establishes an underground drainage.

The condition of the Pecos basin may be characterized roughly as follows: Merchantable timber land, 1,300 square miles; woodland, 2,400 square miles; 300 square miles of burnt and cut-over land, and the remaining area of about 27,000 square miles is open and sage-brush land.

The rainfall along the Pecos in New Mexico ranges from 20 to 25 inches in the mountainous sections, as above Las Vegas and at Cloudcroft, to about 15 inches in the plains country, or in the vicinity of Roswell and Carlsbad. Through Texas the rainfall is light, the annual average being about 12 inches.

During the winter period the flow of the Pecos is supplied mainly by springs. The river has been known to go dry in the neighborhood of Colonias, N. Mex.

Considerable ice forms on the upper Pecos and heavy snows are common. In the vicinity of Santa Rosa and Fort Sumner thin ice and slush ice are in evidence during a part of the winter. Lower down the valley there is an occasional light snow, which disappears very quickly, and at times there is thin ice along the edges of the river. In the lower end of the valley the climate is mild. The rainfall comes mainly in the summer months in the form of showers, and is variable and uncertain.

Irrigation in New Mexico has reached its highest stage of development in the lower Pecos Valley, the irrigated district beginning a short distance above Roswell and continuing into Texas. Thousands of acres are under cultivation, and a wise and economical system of reservoirs and canals is in force. The surface waters have been greatly augmented during the past few years by numerous artesian wells. Above this fertile belt comparatively little farming is engaged in; below it irrigation is carried on only in a small way, as the return seepage water contains, unfortunately, a great percentage of alkali, which renders it undesirable for irrigation.

The recently completed Carlsbad and Hondo projects (Pls. IV and III, *B*) of the Reclamation Service provide for the irrigation of 20,000 and 10,000 acres, respectively, while the proposed Urton Lake project, which is to be relinquished by the Reclamation Service in favor of a Carey Act project, will result in the irrigation of about 60,000 acres in the vicinity of old Fort Sumner, N. Mex.

Numerous reservoir sites are to be found along the Pecos and its tributaries. Among the reservoirs now in operation may be mentioned Lake McMillan on the Pecos, and the Hondo reservoir on the Hondo River. Urton Lake, a natural depression in the vicinity of Fort Sumner, will have a storage capacity of 190,000 acre-feet. It is to be supplied by a feeder canal from the Pecos River. On account of the large amount of silt carried by this stream the prevention of its deposition must be taken into account and provided for in the construction of reservoirs.

On account of its long periods of low water, this stream does not offer many favorable opportunities for the development of power. At present there are no water-power plants of any importance in operation in the basin, except a public-utility plant of about 300 horsepower at Carlsbad, N. Mex. Later there may be some power development in connection with irrigation projects.

The records along this stream are very fragmentary, and most of them were taken within the last five or six years. From them it would appear that 1903 was a very low year and 1905 an unusually high one.

Following is a list of gaging stations maintained in this drainage, together with the length of record:

Pecos River near Santa Rosa, N. Mex., 1903–1906.
Pecos River near Fort Sumner, N. Mex., 1904–1908.
Pecos River near Roswell, N. Mex., 1903–1906.
Pecos River near Dayton, N. Mex., 1905–1908.
Pecos River near Lakewood, N. Mex., 1906–1908.
Pecos River at Avalon, N. Mex., 1906–7
Pecos River at Carlsbad, N. Mex., 1903–1908.
Pecos River near Pecos, Tex., 1898–1907.
Marguerreta flume near Pecos, Tex., 1898, 1900–1907.
Pecos River near Moorhead, Tex., 1900–1908.
Pecos River at High Bridge, near Lozier, Tex., 1898.
Gallinas River near Las Vegas, N. Mex., 1903–1908.
Taylor Moore ditch near Roswell, N. Mex., 1905.
Hondo River below Hondo reservoir, N. Mex., 1903–1906.
Hondo reservoir inlet near Hondo reservoir, N. Mex., 1906–1908.
Hondo reservoir scour gate No. 1 near Hondo reservoir, N. Mex., 1906.
Hondo River near Roswell, N. Mex., 1903–1906.
Penasco River near Dayton, N. Mex., 1905–1908.
Lake McMillan at Lakewood, N. Mex., 1906–7.

PECOS RIVER NEAR FORT SUMNER, N. MEX.

The station, which was established on June 12, 1904, to determine the amount of water available for the Urton Lake project of the United States Reclamation Service, is located at a place known as Arinosa, about 12 miles northwest of old Fort Sumner, N. Mex., and 4 miles upstream from Fort Sumner, a station on the Belen cut-off of the Atchison, Topeka and Santa Fe Railway, and is near the site of the proposed diversion dam and a few miles below Arroyo Salada.

All the tributaries for a long distance above and below the station are intermittent in character, and only occasionally carry large amounts of water. The drainage area at the station is about 5,300 square miles.

Some irrigation is practiced along the bottom land at various localities above the station, but not enough to materially affect the flow of the stream. The proposed Urton Lake project will divert a considerable portion of the stream flow at this point.

Slush ice sometimes forms at this station, and thin ice forms along the edges of the river, but results are not greatly affected by the ice conditions.

On July 5, 1905, the gage and station were moved downstream and a new gage established at the present datum. Otherwise there has been no change in datum.

A. LAKE McMILLAN RESERVOIR, CARLSBAD PROJECT, NEW MEXICO.

B. MAIN AVALON CANAL FROM HEAD-GATES OF AVALON DAM, CARLSBAD PROJECT, NEW MEXICO.

On account of the extremely shifting character of the channel, it is impossible to make reliable estimates of discharge unless very frequent gagings are taken. The funds available for 1907 and 1908 were entirely inadequate to permit any but very rough estimates of discharge for 1907, and did not permit any estimates for 1908.

Discharge measurements of Pecos River near Fort Sumner, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 15	W. A. Lamb	61	49	2.10	93
March 4	do	162	67	2.03	86
April 16	do	185	146	2.20	390
April 24	do	165	135	2.20	365
May 7	do	189	222	2.40	633
May 23	do	166	147	2.35	483
June 12	do	188	204	2.45	593
June 22	do	184	157	2.40	503
September 27	V. L. Sullivan	140	53	2.20	117
December 23	do	215	101	2.20	[a] 132
1908.					
April 20	R. L. Cooper	191	160	2.30	287
August 8	do	190	211	2.70	630
November 5	do	122	77	2.25	102

[a] Made 1 mile below gage.

Daily gage height, in feet, of Pecos River near Fort Sumner, N. Mex., for 1907 and 1908.

[J. C. Pacheco, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.92	2.02	2.10	2.05	2.35	2.32	2.18	2.42	2.38	2.00	2.05	2.20
2	1.90	2.02	2.10	2.02	2.40	2.32	2.12	2.15	2.35	2.00	2.02	2.20
3	1.90	2.02	2.15	2.05	2.25	2.45	2.10	2.32	2.40	2.02	2.12	2.22
4	1.95	2.00	2.05	2.20	2.35	2.35	2.10	2.48	2.35	2.05	2.02	2.22
5	2.02	2.05	2.05	1.95	2.30	2.35	2.10	2.22	2.42	2.05	2.08	2.25
6	2.00	2.02	2.00	1.98	2.32	2.50	2.10	2.02	2.32	2.28	2.10	2.25
7	2.02	2.00	2.00	1.98	2.35	2.42	2.05	2.12	2.30	2.30	2.10	2.22
8	2.00	2.00	2.02	2.10	2.40	2.35	2.05	2.12	2.42	2.22	2.12	2.25
9	2.05	2.00	2.02	2.10	2.35	2.35	2.08	2.02	2.42	2.22	2.10	2.25
10	2.05	2.02	2.05	2.05	2.35	2.35	2.10	2.02	2.42	2.22	2.15	2.22
11	2.05	2.00	2.05	2.02	2.48	2.45	2.10	2.00	2.40	2.25	2.10	2.20
12	2.00	2.05	2.02	2.05	2.32	2.50	2.25	2.02	2.30	2.22	2.15	2.20
13	2.00	2.05	2.02	2.05	2.42	2.35	2.05	1.92	2.18	2.00	2.12	2.22
14	2.00	2.05	2.05	2.02	2.42	2.28	2.02	1.90	2.10	2.05	2.08	2.25
15	2.05	2.02	2.02	2.08	2.62	2.52	2.22	1.90	2.12	2.25	2.22	2.22
16	2.05	2.00	2.00	2.22	2.52	2.72	2.10	1.92	2.08	2.25	2.25	2.25
17	1.95	2.02	2.00	2.12	2.52	2.65	1.95	1.92	2.08	2.22	2.22	2.25
18	1.92	2.02	2.05	2.20	2.45	2.70	2.42	1.92	2.12	2.25	2.25	2.25
19	2.95	2.12	2.00	2.12	2.42	2.58	2.60	1.92	2.22	2.22	2.35	2.25
20	2.82	2.12	2.02	2.12	2.50	2.55	2.58	1.92	2.12	2.25	2.32	2.25
21	2.02	2.12	2.05	2.05	2.40	2.52	2.10	2.25	2.12	3.05	2.30	2.25
22	2.00	2.12	2.10	2.22	2.48	2.42	2.75	2.80	2.08	2.32	2.22	2.22
23	2.00	2.15	2.22	2.20	2.50	2.40	2.35	2.28	2.02	2.12	2.22	2.25
24	2.02	2.10	2.20	2.25	2.42	2.45	2.20	2.18	2.02	2.62	2.22	2.20
25	2.00	2.10	2.20	2.22	2.32	2.38	2.22	2.18	2.00	2.52	2.20	2.32
26	2.02	2.15	2.15	2.25	2.42	2.32	2.52	2.18	2.00	2.08	2.22	2.25
27	2.02	2.10	2.22	2.32	2.42	2.30	2.10	2.45	2.12	2.02	2.25	2.20
28	2.02	2.05	2.22	2.18	2.40	2.28	2.18	2.22	2.22	2.15	2.25	2.25
29	1.95	.....	2.05	2.28	2.32	2.22	3.92	2.22	2.22	2.12	2.22	2.25
30	1.95	.....	2.00	2.32	2.35	2.20	2.45	2.22	2.10	2.05	2.22	2.25
31	2.00	.....	2.00	.....	2.52	.....	1.95	2.35	.....	2.03	.....	2.22

Daily gage height, in feet, of Pecos River near Fort Sumner, N. Mex., etc.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	2.3	1.9	2.05	2.1	2.3	2.15	2.3	2.5	2.3	2.1	2.2	2.4
2	2.3	1.95	2.0	2.1	2.3	2.2	2.2	2.85	2.2	2.1	2.25	2.35
3	2.3	2.05	2.1	2.15	2.2	2.25	2.55	2.9	2.3	2.1	2.25	2.35
4	2.3	2.15	2.1	2.1	2.2	2.2	2.2	2.8	2.55	2.1	2.25	2.3
5	2.35	2.05	2.1	2.1	2.2	2.15	2.1	2.75	2.3	2.1	2.2	2.35
6	2.3	2.0	2.1	2.1	2.3	2.15	2.05	2.7	2.3	2.1	2.25	2.3
7	2.3	2.0	2.15	2.1	2.3	2.1	2.0	2.7	2.15	2.1	2.25	2.25
8	2.25	2.0	2.15	2.1	2.2	2.15	2.05	3.1	2.1	2.2	2.2	2.3
9	2.2	2.0	2.1	2.15	2.2	2.2	2.05	3.0	2.0	2.2	2.2	2.3
10	2.2	2.0	2.15	2.15	2.2	2.1	2.05	2.55	2.05	2.2	2.2	2.35
11	2.2	2.0	2.1	2.1	2.15	2.1	2.1	2.4	2.0	2.25	2.2	2.3
12	2.2	2.05	2.1	2.1	2.15	2.15	2.1	2.4	2.0	2.2	2.2	2.3
13	2.2	2.0	2.1	2.1	2.2	2.05	2.1	2.5	2.0	2.2	2.25	2.35
14	2.1	2.05	2.15	2.05	2.3	2.05	2.1	3.0	2.0	2.2	2.25	2.3
15	2.05	2.0	2.15	2.05	2.3	2.05	2.2	3.1	2.0	2.2	2.25	2.2
16	2.05	2.0	2.05	2.1	2.25	2.05	2.15	2.65	2.1	2.2	2.25	2.2
17	1.95	1.95	2.1	2.1	2.25	2.1	2.3	2.5	2.05	2.2	2.25	2.2
18	1.9	1.95	2.05	2.1	2.25	2.1	2.3	2.5	2.1	2.2	2.25	2.25
19	1.9	2.05	2.05	2.3	2.25	2.05	2.85	2.5	2.0	2.15	2.2	2.2
20	1.9	2.05	2.0	2.3	2.2	2.0	2.3	2.6	2.15	2.2	2.2	2.25
21	1.9	2.05	2.05	2.3	2.2	2.0	2.6	4.95	2.1	2.2	2.25	2.25
22	1.9	2.0	2.05	2.3	2.25	2.0	2.5	3.2	2.0	2.2	2.25	2.2
23	1.9	2.1	2.05	2.3	2.8	2.0	2.4	3.25	2.0	2.25	2.25	2.3
24	1.9	2.15	2.15	2.25	2.2	1.95	2.4	2.6	2.1	2.25	2.25	2.3
25	1.95	2.15	2.05	2.2	2.25	1.95	2.4	2.0	2.15	2.2	2.2	2.3
26	1.9	2.1	2.0	2.3	2.2	2.0	2.4	2.05	2.1	2.25	2.25	2.3
27	1.9	2.1	2.0	2.45	2.2	2.0	2.5	2.05	2.2	2.2	2.25	2.35
28	1.9	2.0	2.05	2.4	2.3	2.3	2.5	2.4	2.2	2.2	2.25	2.3
29	1.9	2.05	2.05	2.3	2.25	2.3	2.4	2.4	2.2	2.2	2.25	2.35
30	1.9	.....	2.05	2.3	2.2	2.3	2.75	2.5	2.1	2.2	2.3	2.35
31	1.9	.....	2.1	.....	2.2	.....	2.6	2.0	.....	2.2	.....	2.35

Daily discharge, in second-feet, of Pecos River near Fort Sumner, N. Mex., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	45	65	110	215	560	340	250	440	290	60	60	120
2	40	65	110	200	630	340	210	200	270	60	60	120
3	40	65	135	215	430	590	200	340	310	60	90	130
4	50	60	95	345	560	460	200	520	270	70	60	130
5	65	75	95	160	500	460	200	220	330	70	80	150
6	60	65	95	175	520	670	200	110	240	160	80	150
7	65	60	95	175	560	540	160	150	230	180	80	130
8	60	60	105	265	605	460	160	150	260	130	90	150
9	75	60	105	280	540	460	180	110	260	130	80	150
10	75	65	115	240	540	460	200	110	260	130	100	130
11	75	60	140	220	730	590	200	100	240	150	80	120
12	60	75	130	240	500	670	310	110	180	130	100	120
13	60	75	130	240	600	460	160	70	120	60	90	130
14	60	75	140	220	600	380	150	60	80	70	80	150
15	75	65	145	260	940	700	280	60	90	150	130	130
16	75	60	135	420	760	1,070	200	70	80	150	150	150
17	50	65	135	300	760	930	120	70	80	130	130	150
18	45	65	155	370	620	1,030	440	70	90	150	150	150
19	1,120	110	145	300	580	800	690	70	130	130	210	150
20	880	110	160	300	700	750	660	70	90	150	190	150
21	65	115	170	240	550	700	170	240	90	1,200	180	150
22	60	115	200	420	660	540	950	980	80	190	130	130
23	60	120	330	370	700	520	360	260	60	90	130	150
24	65	100	305	430	540	590	240	160	60	460	130	120
25	60	100	305	420	420	500	250	160	60	350	120	190
26	65	125	260	430	540	420	560	160	60	80	130	150
27	65	105	350	520	540	400	170	360	90	60	150	120
28	65	85	350	340	520	380	220	180	130	100	150	150
29	50	.....	205	470	420	320	3,800	180	130	90	130	150
30	50	.....	170	520	460	300	480	180	80	70	130	150
31	60	.....	170	.....	700	.....	100	270	.....	60	.....	130

NOTE.—The above discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Pecos River near Fort Sumner, N. Mex., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	1,120	40	121	7,440
February	125	60	80.9	4,490
March	350	95	171	10,500
April	520	160	310	18,400
May	940	420	590	36,300
June	1,070	300	561	33,400
July	3,800	100	402	24,700
August	980	60	201	12,400
September	330	60	158	9,400
October	1,200	60	164	10,100
November	210	60	116	6,900
Deecember	190	120	140	8,610
The year	3,800	40	251	183,000

NOTE.—The above estimates are in general only approximate.

PECOS RIVER NEAR DAYTON, N. MEX.

This station, which was established March 24, 1905, has been maintained in connection with the Carlsbad irrigation project in New Mexico to determine the amount of water supplied by the river to the McMillan reservoir, and is located about 3 miles east of Dayton, N. Mex., about 6 miles above the dam of the reservoir, and approximately 100 feet downstream from the mouth of Penasco River.

Considerable irrigation is practiced in the vicinity of Roswell, N. Mex., and opportunities for irrigation projects exist at various points above. The winters in this vicinity are comparatively mild, and ice does not appreciably affect stream flow.

The original gage was washed out on September 6, 1905, and was relocated September 7, 1905, at a point about one-half mile upstream. Otherwise there has been no change in gage datum. Fair results can be obtained at this station if discharge measurements are taken at frequent intervals. This station was transferred March 31, 1908, to the United States Reclamation Service, by which discharge measurements have been made since.

Discharge measurements of Pecos River near Dayton, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 20	W. A. Lamb	98	239	3.10	338
March 27	do	80	97	2.05	104
April 26	do	103	196	3.37	351
May 17	do	143	261	3.70	479
May 31	do	133	233	3.65	467
June 28	do	140	212	3.30	323
December 30	L. E. Foster	94	182	3.40	321
1908.					
April 15	United States Reclamation Service			2.30	124
May 18	do			2.20	90
June 10	do			2.00	70
June 19	do			1.80	46
July 23	do			4.60	964
August 7	do			4.60	945
August 25	do			5.70	2,630
Do	do			6.30	3,190
August 26	do			5.40	1,560
August 31	do			3.90	350
December 6	do			3.80	301

Daily gage height, in feet, of Pecos River near Dayton, N. Mex., for 1907 and 1908.

[Lemo Weddle and Eugene Lattion, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.2	3.2	2.5	2.8	3.1	4.0	2.9	4.0	4.0	2.1	3.8	3.7
2	3.1	3.3	2.6	2.9	3.2	3.8	2.8	3.3	4.3	2.1	3.7	3.4
3	3.1	3.5	2.6	2.8	3.1	3.7	2.7	3.0	4.0	2.4	3.5	3.4
4	3.4	3.1	2.5	2.9	3.0	3.8	2.6	2.9	3.9	2.2	3.5	3.4
5	3.2	3.3	2.4	2.7	3.2	3.8	2.6	3.5	3.9	2.4	3.4	3.4
6	3.2	3.1	2.4	2.6	3.5	3.8	2.5	3.3	3.3	2.4	3.3	3.5
7	3.1	3.0	2.4	2.5	3.4	3.7	2.4	3.0	3.4	2.2	3.3	[a]8.5
8	3.0	3.0	2.5	2.5	3.4	3.6	2.2	3.0	3.5	2.2	3.3	3.6
9	3.3	3.0	2.4	2.6	3.3	3.9	2.2	3.0	3.5	2.3	3.3	3.5
10	3.5	3.4	2.3	2.5	3.5	3.9	2.2	2.9	3.4	2.3	3.3	3.4
11	3.5	3.5	2.4	2.4	3.5	3.9	2.1	2.8	3.3	2.3	3.3	3.2
12	3.4	3.3	2.2	2.3	3.5	4.0	2.1	2.7	3.1	2.5	3.2	3.5
13	3.4	3.2	2.0	2.3	3.8	3.7	2.0	2.6	2.9	2.7	3.2	3.2
14	3.4	3.1	1.9	2.2	3.7	3.8	4.0	2.6	2.9	2.4	3.4	3.4
15	3.3	3.5	2.1	2.2	3.6	3.7	3.7	2.5	2.7	2.6	3.2	3.2
16	3.3	3.4	2.3	2.1	3.5	3.6	3.2	2.3	2.7	2.5	3.3	3.5
17	3.3	3.4	2.3	2.1	3.6	3.5	2.9	2.4	2.7	2.5	3.5	3.5
18	3.4	3.0	2.3	2.2	3.6	4.2	2.9	2.2	2.6	2.5	4.0	3.5
19	3.5	3.9	2.2	2.3	3.7	4.4	2.7	2.1	2.5	2.6	4.0	3.5
20	3.6	3.1	2.2	2.8	3.6	4.7	2.5	2.6	2.5	2.7	4.1	3.5
21	3.5	3.1	2.2	3.3	3.4	4.2	2.4	2.9	2.6	2.7	4.2	3.7
22	3.5	3.0	2.2	3.1	3.4	4.2	3.9	3.9	2.6	3.0	4.1	3.6
23	3.5	3.0	2.2	3.4	3.2	4.0	4.9	3.1	2.7	4.0	3.7	3.5
24	3.5	2.9	2.2	3.5	3.1	3.9	4.3	4.9	2.7	3.8	3.5	3.5
25	3.4	3.0	2.2	3.4	3.0	3.5	3.7	4.3	2.7	4.0	3.6	3.5
26	3.2	2.9	2.1	3.3	3.2	3.4	3.5	3.8	2.6	4.2	3.5	3.6
27	3.4	2.6	2.0	3.3	3.4	3.4	3.7	3.4	2.6	4.4	3.4	3.6
28	3.4	2.6	2.0	3.0	3.4	3.2	3.7	3.5	2.5	5.0	3.3	3.6
29	3.2	.....	2.0	3.0	3.5	3.1	3.6	3.7	2.1	6.8	3.2	3.2
30	3.2	.....	2.7	3.1	3.6	3.0	7.0	4.0	2.2	5.0	3.8	3.5
31	3.2	.....	3.0	.....	3.6	.....	5.3	3.8	.....	4.5	.....	3.5
1908.												
1	3.5	3.2	2.7	.....	2.4	2.4	2.2	3.9	4.5	2.7	3.0	3.8
2	3.6	3.2	2.6	.....	2.6	2.7	2.0	4.7	5.5	2.6	3.0	4.6
3	3.5	3.3	2.5	.....	2.8	2.3	2.0	6.6	4.9	2.6	3.0	4.2
4	3.4	3.2	2.5	.....	2.6	2.1	2.7	5.6	4.6	2.5	3.0	4.2
5	3.6	3.4	2.3	.....	2.7	2.1	4.6	4.7	4.1	2.5	3.2	4.0
6	3.5	3.3	2.3	.....	2.6	2.3	4.7	4.7	4.3	2.5	3.2	4.0
7	3.5	3.3	2.3	.....	2.5	2.3	4.5	4.5	4.0	2.6	3.2	3.8
8	3.5	3.4	2.3	.....	2.4	2.3	4.0	4.5	3.9	2.7	3.2	3.8
9	3.6	3.5	2.3	.....	2.3	2.2	3.0	3.0	3.7	2.7	3.2	3.8
10	3.5	3.5	2.3	.....	2.3	2.0	3.0	2.4	3.7	2.7	3.2	4.0
11	3.8	3.5	2.3	.....	2.2	2.0	2.7	5.5	3.7	2.7	3.2	4.0
12	3.5	3.4	2.3	.....	2.3	2.0	2.7	5.4	3.5	2.6	3.2	3.8
13	3.7	3.4	2.3	.....	2.3	2.1	2.5	4.4	3.3	2.6	3.2	3.8
14	3.6	3.5	2.3	.....	2.2	2.0	2.5	5.7	3.1	2.5	3.2	4.0
15	3.6	3.5	2.3	2.3	2.2	2.0	2.7	5.0	3.3	2.5	3.2	4.0
16	3.4	3.5	2.3	.....	2.3	2.0	2.3	4.8	3.2	2.4	3.2	4.0
17	3.6	3.4	2.2	.....	2.3	2.0	2.3	5.4	3.1	2.6	3.2	4.0
18	3.7	3.0	2.2	.....	2.2	1.9	2.3	4.8	3.2	2.6	3.3	4.0
19	3.2	2.9	2.2	.....	2.3	1.8	2.3	4.7	3.0	2.6	3.3	3.8
20	3.4	2.8	2.2	.....	2.2	2.0	5.6	4.4	2.9	2.5	3.3	3.8
21	3.3	2.8	2.2	.....	2.0	1.9	3.9	6.0	2.8	2.5	3.3	3.7
22	3.4	2.8	2.1	.....	2.0	1.9	4.6	4.7	2.8	3.7	3.6	3.7
23	3.5	2.9	2.1	.....	2.0	1.8	4.6	6.4	2.9	2.7	3.7	3.7
24	3.4	2.6	2.1	.....	2.0	1.8	4.6	9.0	2.7	2.5	3.6	3.8
25	3.4	2.8	2.1	.....	2.0	2.5	4.0	[b]5.6	2.7	2.6	3.6	3.9
26	3.5	2.7	2.1	.....	2.1	2.4	3.6	5.4	2.7	2.6	3.5	4.0
27	3.3	2.6	2.1	.....	3.0	2.4	3.4	4.7	2.8	2.5	3.5	4.0
28	3.4	2.6	2.1	.....	2.8	2.0	3.3	4.7	2.7	2.5	3.5	3.9
29	3.3	2.6	2.1	.....	2.8	1.8	3.0	4.7	3.1	2.5	3.6	3.9
30	3.1	.....	2.1	.....	2.6	1.7	2.9	4.1	2.7	3.0	3.8	3.9
31	3.3	.....	2.1	.....	2.7	.....	3.8	3.9	.....	3.0	.....	3.9

[a] December 7, 1907, gage height doubtful.

[b] August 25, 1908, gage height is mean of observer's reading and two separate readings by hydrographer made during the day.

NOTE.—Gage heights for April, 1908, are missing.

Rating tables for Pecos River near Dayton, N. Mex.

JANUARY 1, 1907, TO APRIL 20, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	90	2.50	165	3.10	355	3.70	695
2.00	100	2.60	185	3.20	395	3.80	765
2.10	110	2.70	205	3.30	445	3.90	835
2.20	120	2.80	235	3.40	505		
2.30	130	2.90	275	3.50	565		
2.40	145	3.00	315	3.60	630		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and on the form of preceding curves. It is not well defined.

APRIL 21, 1907, TO DECEMBER 31, 1907.

2.00	73	2.90	185	3.80	540	4.70	1260
2.10	80	3.00	210	3.90	610	4.80	1350
2.20	87	3.10	240	4.00	680	4.90	1450
2.30	95	3.20	270	4.10	750	5.00	1550
2.40	105	3.30	300	4.20	830	5.10	1650
2.50	115	3.40	340	4.30	910	5.20	1750
2.60	125	3.50	380	4.40	990	5.30	1860
2.70	140	3.60	430	4.50	1080	5.40	1970
2.80	160	3.70	480	4.60	1170	5.50	2080

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and the form of the preceding curves. It is not well defined. Discharges above the limits of the rating table estimated.

Daily discharge, in second-feet, of Pecos River near Dayton, N. Mex., for 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	370	275	150	75	135	140	105	460	680	45	85	300
2	415	275	130	75	190	220	70	1,040	1,520	35	85	750
3	370	315	110	75	250	125	70	2,840	1,000	35	85	495
4	330	275	110	75	190	90	240	1,840	750	30	85	495
5	420	360	80	80	220	90	1,520	1,030	440	30	125	390
6	375	310	80	80	190	125	1,620	1,030	545	30	125	390
7	375	310	80	85	160	125	1,390	870	390	35	125	301
8	375	360	80	85	135	125	930	880	340	45	125	301
9	420	410	80	90	115	105	300	140	260	45	125	301
10	375	415	80	95	115	70	290	50	260	45	125	390
11	530	420	80	100	95	70	175	1,830	260	45	125	390
12	375	360	80	110	115	70	165	1,780	200	35	125	300
13	485	360	80	115	115	90	110	935	150	35	125	300
14	430	425	80	120	95	70	100	2,140	105	30	125	390
15	430	425	80	124	95	70	140	1,520	150	30	125	390
16	340	430	80	124	110	70	60	1,380	125	28	125	390
17	430	375	70	124	110	70	55	1,980	105	35	125	390
18	485	220	70	124	90	60	50	1,450	125	35	150	390
19	260	190	70	124	110	46	45	1,400	85	35	150	300
20	340	170	70	124	90	70	1,950	1,180	70	30	150	300
21	300	170	70	124	65	60	515	2,740	55	30	150	260
22	340	170	60	124	65	60	1,000	1,520	55	260	230	260
23	390	200	60	124	65	46	964	3,300	70	45	260	260
24	345	120	60	124	65	46	965	a7,300	45	30	230	300
25	345	170	60	124	65	175	525	2,490	45	35	230	340
26	390	140	65	124	80	150	330	1,560	45	35	200	390
27	310	125	65	130	330	150	250	950	55	30	200	390
28	350	125	65	130	250	70	220	950	45	30	200	340
29	310	125	65	130	250	46	140	950	105	30	230	340
30	235	.....	65	130	190	40	120	520	45	85	300	340
31	310	.....	65	.....	220	.....	410	350	.....	85	.....	340

a Estimated.

NOTE.—These discharges were obtained by the indirect method for shifting channels. Discharge for April estimated.

Monthly discharge of Pecos River near Dayton, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	630	315	469	28,800	B.
February	835	185	395	21,900	B.
March	315	90	139	8,500	C.
April	380	110	210	12,500	D.
May	540	210	352	21,600	B.
June	1,260	210	562	33,400	C.
July	3,700	73	464	28,500	C.
August	1,450	80	335	20,600	C.
September	910	80	271	16,100	C.
October	3,450	80	446	27,400	C.
November	830	270	419	24,900	C.
December	2,000	270	425	26,100	C.
The year	3,700	80	374	270,000	
1908.					
January	530	235	373	22,900	C.
February	430	120	277	15,900	C.
March	150	60	78.7	4,840	C.
April	130	75	109	6,490	C.
May	330	65	138	8,480	B.
June	220	40	91.5	5,440	B.
July	1,950	45	478	29,400	C.
August	7,300	50	1,560	95,900	C.
September	1,520	45	271	16,100	C.
October	260	28	45.4	2,790	C.
November	300	85	155	9,220	C.
December	750	260	362	22,300	C.
The year	7,300	28	328	240,000	

NOTE.—Discharge estimated for July 30, October 29, and December 7, 1907, and August 24, 1908; also April, 1908.

PECOS RIVER NEAR LAKEWOOD, N. MEX.

The station, which was established January 11, 1906, and abandoned March 31, 1908, was located 3 miles southeast of Lakewood and one-half mile below McMillan reservoir dam (Pl. IV, *A*).

The station was maintained in connection with the Carlsbad project of the United States Reclamation Service for the purpose of comparing the amount of water available at the McMillan reservoir with that below the Avalon dam. The record shows the discharge from the gates of the dam, but does not include the discharge from the spillway nor any leakage from the reservoir.

The present gage was established May 8, 1906. It had been previously moved from original location on February 8, 1906.

Fair results can be obtained at this station if occasional discharge measurements are made at different stages.

Discharge measurements of Pecos River near Lakewood, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 20	W. A. Lamb	8.5	6.4	0.19	11.9
May 17	do	77	142	[a] 1.25	236
June 28	do	76	119	.90	141

[a] Gage height recorded 1.75 feet by hydrographer; it is believed to have been in error 0.5 foot.

Daily gage height, in feet, of Pecos River near Lakewood, N. Mex., for 1907 and 1908

[H. C. Halcomb, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.1	0.2	1.22	0.2	0.6	0.7	0.9	3.08	2.55	0.35	4.7	1.8
2	.1	.2	2.3	.2	.6	1.4	1.15	1.4	1.8	.35	3.2	1.8
3	.1	.2	2.28	.2	.6	2.1	1.4	1.3	1.8	.35	2.1	1.75
4	.1	.2	.2	.2	.6	2.1	1.4	1.3	1.8	.35	2.1	1.75
5	.1	.2	.2	.2	.6	2.1	1.12	1.3	1.8	.35	1.35	1.75
6	.1	.2	.2	.2	.2	1.75	.9	1.3	1.8	.35	1.45	1.7
7	1.75	.2	.2	.2	.2	1.1	.9	1.3	1.5	.35	1.55	1.7
8	2.38	.2	.2	.2	.2	1.1	.8	1.3	1.0	.35	1.55	1.65
9	2.98	1.44	.2	.2	.6	1.1	.8	1.3	1.0	.35	1.6	1.65
10	3.28	2.8	.2	.2	.6	1.1	.8	1.15	1.0	.35	1.6	1.6
11	3.42	2.75	.2	.2	.6	.75	.8	1.0	1.0	.35	1.6	1.6
12	3.52	2.68	.2	.2	2.0	.75	.8	1.0	.7	.35	1.6	1.6
13	3.45	.2	.2	.2	2.0	.75	.8	1.0	.7	.35	1.6	1.6
14	3.75	.2	.2	.2	1.45	.75	.8	1.12	.7	.35	1.6	1.6
15	.15	.2	.2	.2	1.2	.75	.8	1.25	.7	.3	1.6	1.6
16	.15	.2	.2	.2	1.2	1.42	.8	1.25	.7	.3	1.6	1.6
17	.15	.2	.2	.2	1.2	2.75	.8	1.25	.7	.3	1.6	1.6
18	.15	.2	.2	.2	1.6	2.75	.8	1.0	.35	.3	1.6	1.6
19	.15	.2	.2	.55	2.0	2.7	.8	1.0	.35	.3	1.65	1.6
20	.15	.2	.2	.55	1.5	4.0	.8	1.0	.35	.3	1.7	1.6
21	.15	.2	.2	.55	1.5	4.0	.8	1.05	.35	.3	1.75	1.6
22	.15	.2	.2	.55	1.5	3.95	.8	3.0	.35	.3	1.8	1.6
23	.15	.2	.2	.4	1.5	2.1	.8	1.2	.35	.3	1.9	1.65
24	.15	.2	.2	.4	.9	1.0	.8	1.2	.35	1.05	1.9	1.65
25	.15	.98	.2	.4	.7	1.65	.75	1.2	.35	1.8	1.9	1.7
26	3.2	2.12	.2	.2	.7	1.65	.75	1.3	.35	1.8	1.85	1.7
27	3.4	2.3	.2	.2	.7	1.6	.75	1.3	.35	2.2	1.85	1.7
28	3.3	2.25	.2	.2	.7	1.25	.75	1.3	.35	4.5	1.85	1.7
29	1.61	.....	.2	.2	.7	.9	.75	1.3	.35	5.6	1.8	1.7
30	.1	.....	.2	.2	.7	.9	3.1	1.1	.35	5.6	1.8	1.7
31	.2	.....	.2	.....	.7	.....	4.7	2.65	.....	5.2	.....	1.7

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	1.6	1.5	0.1	11	1.6	0.8	0.1	21	1.5	0.2	0.1
2	1.6	1.4	.1	12	1.6	.8	.1	22	1.5	.2	.1
3	1.6	1.4	.1	13	1.6	.8	.1	23	1.5	.2	.1
4	1.6	.8	.1	14	1.6	.8	.1	24	1.5	.1	.1
5	1.6	.8	.1	15	1.55	.8	.1	25	1.5	.1	.1
6	1.6	.8	.1	16	1.55	.2	.1	26	1.5	.1	.1
7	1.6	.8	.1	17	1.5	.2	.1	27	1.5	.1	.1
8	1.6	.8	.1	18	1.5	.2	.1	28	1.5	.1	.1
9	1.6	.8	.1	19	1.5	.2	.1	29	1.5	.1	.1
10	1.6	.8	.1	20	1.5	.2	.1	30	1.5	.....	.1
								31	1.5	.....	.1

Rating table for Pecos River near Lakewood, N. Mex., for January 1, 1907, to March 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
0.10	5	1.20	205	2.30	585	3.80	1,320
.20	14	1.30	230	2.40	630	4.00	1,430
.30	28	1.40	260	2.50	675	4.20	1,540
.40	44	1.50	290	2.60	720	4.40	1,660
.50	60	1.60	320	2.70	765	4.60	1,780
.60	76	1.70	355	2.80	810	4.80	1,900
.70	95	1.80	390	2.90	855	5.00	2,025
.80	115	1.90	425	3.00	905	5.20	2,155
.90	135	2.00	465	3.20	1,005	5.40	2,285
1.00	155	2.10	505	3.40	1,105	5.60	2,415
1.10	180	2.20	545	3.60	1,210		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on six discharge measurements made during 1906 and 1907, and is well defined. Above 1.6 feet it is the same as the rating table covering period May 8–December 31, 1906.

Monthly discharge of Pecos River near Lakewood, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	1,290	5	364	22,400	A.
February	810	14	169	9,390	B.
March	577	14	56.9	3,500	B.
April	68	14	24.2	1,440	C.
May	465	14	168	10,300	B.
June	1,430	95	417	24,800	A.
July	1,840	105	212	13,000	B.
August	945	155	268	16,500	B.
September	698	36	153	9,100	B.
October	2,420	36	354	21,800	A.
November	1,840	245	430	25,600	A.
December	390	320	342	21,000	A.
The year	2,420	5	247	179,000	
1908.					
January	320	290	305	18,800	B.
February	290	5	80.4	4,620	B.
March	5	5	5.0	307	D.
The period	.....	.....	.....	23,700	

PECOS RIVER AT AVALON, N. MEX.

The station, which was established on January 6, 1906, and maintained in connection with the Carlsbad project of the United States Reclamation Service, is situated just below the Avalon dam, about 6 miles north of Carlsbad, N. Mex.

The records at this point include the flow at Lakewood, the flow of certain springs between the stations, the discharge of the spillways of the Lake McMillan dam, and that portion of the leakage through the gypsum in the bottom of the reservoir that returns to the river above Avalon.

The gage is about one-half mile below the dam and below the headgates of the main canal of the Carlsbad project (Pl. IV, *B*). A large part of the 20,000 acres to be irrigated under that project was formerly under the system of the Pecos Irrigation Company.

Gage readings were discontinued on March 16, 1907. No change was made in the location or datum of the gage while it was in operation. Good results have been obtained at this station.

Discharge measurements of Pecos River at Avalon, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 23	W. A. Lamb	67	73	0.96	206
April 3	do	30.7	28	2.10	77

Daily gage height, in feet, of Pecos River at Avalon, N. Mex., for 1907.

[W. A. Sewell, observer.]

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1		0.9	*a* 1.1	11	*a* 2.6	*a* 2.5	0.9	21	0.9	0.8	
2		.9	*a* 1.9	12	*a* 2.5	*a* 2.5	.9	22	.9	.9	
3		.9	*a* 2.2	13	*a* 2.5	1.0	.9	23	.9	.9	
4		.8	1.0	14	*a* 2.4	.9	.9	24	.8	.9	
5		.8	1.0	15	1.0	.9	.9	25	.8	*a*.9	
6		.9	.9	16	1.0	.9	.9	26	*a* 2.3	2.0	
7		.9	.9	17	.9	.9		27	*a* 2.4	2.0	
8		.9	.9	18	.9	.9		28	*a* 2.6	2.0	
9		.9	.9	19	.9	.9		29	*a* 2.5		
10		.9	.9	20	.9	.8		30	1.0		
								31	.9		

a Gage heights read when the gates at Lake McMillan were open; all others were read when the gates were closed.

Rating table for Pecos River at Avalon, N. Mex., for January 1, 1906, to March 16, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	150	1.30	365	1.80	720	2.30	1,210
0.90	180	1.40	425	1.90	810	2.40	1,320
1.00	215	1.50	490	2.00	905	2.50	1,430
1.10	260	1.60	560	2.10	1,005	2.60	1,540
1.20	310	1.70	635	2.20	1,105		

NOTE.—The above table is based on discharge measurements made during the above period and is well defined between gage heights 0.7 foot and 2.75 feet.

Monthly discharge of Pecos River at Avalon, N. Mex., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January 11-31	1,540	150	648	27,000	A.
February	1,430	150	344	19,100	A.
March 1-16	1,100	180	286	9,080	A.
The period				55,200	

PECOS RIVER AT CARLSBAD, N. MEX.

This station, which was established May 20, 1903, was located at the Green Street Bridge, Carlsbad, N. Mex., and about 500 feet below the station of the Pecos Valley and Northeastern Railway. Gage observations were discontinued on March 31, 1908. This bridge and the original gage were washed away in October, 1904. The station was 2,000 feet below the Hagerman power dam.

The Avalon reservoir, from which the main canal of the Carlsbad project is diverted, is located a few miles upstream from this station. Records have been maintained for the United States Reclamation Service.

The gage datum was unchanged during the maintainance of the station.

Fair results were obtained at this station, except at low-water stages, when the rough nature of the stream bed has interfered with the accuracy of measurements. Insufficient measurements were made during 1907-8 to warrant the publication of monthly discharge.

Discharge measurements of Pecos River at Carlsbad, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 19	W. A. Lamb	76	106	1.18	[a] 289
February 28	do	255	1,610	1.95	805
March 25	do	60	48	.95	113
May 1	do	44	44	.84	86

[a] Made by wading 30 feet above gage.

Daily gage height, in feet, of Pecos River at Carlsbad, N. Mex., for 1907 and 1908.

[J. W. Lewis, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.12	1.20	1.20	1.04	0.72	0.82	0.84	2.98	1.85	0.85	3.40	1.58
2	1.13	1.20	1.90	1.05	.71	.93	.82	2.12	1.60	.83	2.88	1.58
3	1.14	1.20	1.90	1.00	.71	1.48	.80	1.55	1.45	.65	2.05	1.58
4	1.14	1.19	1.30	1.00	.71	1.52	.86	1.25	1.45	.80	1.82	1.58
5	1.14	1.18	1.20	1.00	.71	1.53	1.14	1.20	1.51	.85	1.55	1.58
6	1.18	1.18	1.20	.97	.72	1.34	1.17	1.20	1.52	.83	1.60	1.55
7	1.58	1.18	1.20	.95	.71	1.14	.96	1.19	1.52	.64	1.49	1.52
8	1.88	1.18	1.20	.98	.71	.90	.98	1.18	1.39	.85	1.43	1.52
9	2.45	1.18	1.22	.98	.71	.70	.98	1.18	1.25	.91	1.46	1.56
10	2.45	2.18	1.20	.96	.70	.60	.96	1.40	1.20	.94	1.48	1.62
11	2.52	2.20	1.19	.86	.70	.63	.94	1.43	1.20	.95	1.50	1.60
12	2.58	2.20	1.18	.80	.85	.23	.92	1.40	1.15	.95	1.46	1.60
13	2.60	1.20	1.18	.80	1.42	.64	.90	1.38	1.25	92	1.42	1.59
14	2.30	1.20	1.18	.62	1.34	1.33	.90	1.35	1.00	.92	1.42	1.52
15	1.20	1.20	1.18	.67	1.27	1.33	.90	1.18	1.00	.90	1.50	1.48
16	1.20	1.20	1.18	.85	1.18	1.34	.90	.97	1.35	.97	1.48	1.48
17	1.20	1.20	1.18	.72	1.12	1.95	.91	.95	1.25	.96	1.47	1.48
18	1.20	1.20	1.18	.70	1.12	1.96	.91	.95	.96	.92	1.47	1.48
19	1.20	1.20	1.18	.70	1.22	1.99	.91	.90	.98	.96	1.51	1.48
20	1.20	1.20	1.18	.68	1.47	2.22	.94	.88	1.00	.90	1.54	1.48
21	1.20	1.20	1.18	.66	1.56	2.64	.95	.75	1.00	2.25	1.51	1.48
22	1.20	1.20	1.18	.68	1.50	2.50	.95	.66	1.00	1.10	1.55	1.48
23	1.24	1.20	1.00	.68	1.41	1.85	.95	.62	.98	.86	1.62	1.48
24	1.25	1.20	1.00	.72	1.18	1.28	.95	.66	.88	.90	1.64	1.48
25	2.40	1.20	.80	.70	.90	1.68	.95	.86	.85	1.35	1.62	1.48
26	2.44	1.78	.95	.70	.56	1.40	.95	.96	.85	1.54	1.61	1.48
27	2.50	1.80	1.10	.70	.88	1.51	.95	.99	.86	1.48	1.63	1.48
28	2.45	1.91	1.05	.70	.78	1.37	.95	1.10	.92	3.60	1.60	1.48
29	1.95	.....	.89	.70	.96	1.08	.92	1.00	.88	3.52	1.60	1.48
30	1.22	.....	.89	.70	.92	.91	.92	1.00	.85	3.70	1.60	1.50
31	1.20	.....	.92	.....	.89	.....	2.38	1.28	.....	3.62	.....	1.50

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1908.				1908.				1908.			
1	1.50	1.50	1.20	11	1.50	1.30	0.90	21	1.50	1.30	0.70
2	1.50	1.50	1.20	12	1.50	1.25	.90	22	1.50	1.30	.70
3	1.50	1.50	1.20	13	1.50	1.25	.90	23	1.48	1.30	.70
4	1.50	1.50	1.20	14	1.50	1.25	.90	24	1.48	1.30	.70
5	1.50	1.50	1.10	15	1.50	1.20	.80	25	1.45	1.30	.70
6	1.50	1.40	1.00	16	1.50	1.00	.80	26	1.48	1.30	.70
7	1.50	1.40	1.00	17	1.50	1.00	.70	27	1.48	1.30	.70
8	1.50	1.40	1.00	18	1.50	1.00	.70	28	1.50	1.25	.70
9	1.50	1.35	1.00	19	1.50	1.10	.70	29	1.50	1.25	.70
10	1.50	1.35	.90	20	1.50	1.20	.70	30	1.50	.....	.70
								31	1.50	.....	.70

NOTE.—Beginning February 11, 1908, water held back at Lake McMillan for storage.

PECOS RIVER AND MARGUERETTA FLUME NEAR PECOS, TEX.

This station, which was established on January 1, 1898, and discontinued on June 30, 1907, is located at the flume of the Barstow Irrigation Company (old Margueretta Canal Company). The canal diverts water from the west side of Pecos River about 3 miles upstream from this flume, which carries the water across to the east side of the river. The flume is a timber structure supported on pile bents. About 10 second-feet are diverted into the West Valley ditch before the canal crosses the river. The gage in the flume is at the east end and its zero is at the bottom of the flume. This gage registers amount of water used for irrigation on east side of river.

The gaging station on the river shows the amount of water in the river below the canal. The gage is nailed to one of the piles supporting the flume, and discharge measurements are taken 200 yards downstream.

No change has been made in the datum or position of this gage since its establishment. Flood measurements have been made at a highway bridge east of Pecos. The channel is shifting, and the regularity of the flow is considerably affected by the pile supports of the flume.

One measurement was made in the flume in 1899. Daily gage readings, however, were not begun until January 1, 1900.

Discharge measurements of Pecos River near Pecos, Tex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 14	W. A. Lamb	173	419	4.10	1,250
January 22	do	127	175	2.00	301
February 21	do	105	160	1.85	282
March 29	do	39	44	.65	35
April 29	do	20	6	.10	2.9

Mean daily gage height, in feet, of Pecos River near Pecos, Tex., for 1907.

[Lawrence Vaneter, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	1.8	2.8	2.7	0.5	0.1	0.3	16	3.65	2.3	1.1	0.3	0.1	0.9
2	1.7	2.2	2.8	.5	.1	.2	17	2.7	2.1	1.1	.3	.7	1.0
3	1.7	2.1	2.6	.5	.1	.2	18	2.45	2.0	1.1	.3	.7	1.3
4	1.7	2.0	2.4	.6	.1	.2	19	2.3	1.95	1.1	.2	.7	2.65
5	1.7	2.0	2.85	.6	.1	.2	20	2.1	1.8	1.1	.2	.7	2.8
6	1.7	2.0	2.55	.6	.1	.2	21	2.0	1.8	1.1	.2	.7	2.95
7	1.7	2.0	1.9	.5	.1	1.35	22	2.0	1.8	1.0	.2	.8	3.25
8	1.7	1.9	1.6	.5	.1	1.6	23	2.0	1.8	.9	.1	1.05	3.55
9	1.9	1.9	1.6	.5	.1	1.2	24	2.0	1.8	.8	.1	1.2	3.15
10	2.85	1.8	1.5	.4	.1	1.2	25	2.0	1.8	.8	.1	1.2	3.05
11	3.35	1.8	1.5	.4	.1	.9	26	2.0	1.7	.8	.1	1.15	1.4
12	3.6	1.8	1.45	.4	.1	.8	27	1.9	1.7	.65	.1	1.0	1.2
13	3.85	3.2	1.4	.4	.1	.5	28	2.7	1.65	.6	.1	.8	1.75
14	4.05	3.3	1.25	.3	.1	.85	29	3.8	.....	.6	.1	.8	1.55
15	4.05	2.6	1.1	.3	.1	1.0	30	3.8	.....	.5	.1	.6	1.5
							31	3.6	.....	.5	.....	.3	.....

Rating table for Pecos River near Pecos, Tex., for January 1, 1907, to June 30, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	3	1.20	110	2.30	405	3.40	850
.20	6	1.30	130	2.40	440	3.50	900
.30	10	1.40	150	2.50	475	3.60	950
.40	15	1.50	175	2.60	510	3.70	1,005
.50	20	1.60	200	2.70	550	3.80	1,060
.60	30	1.70	225	2.80	590	3.90	1,115
.70	40	1.80	250	2.90	630	4.00	1,170
.80	50	1.90	280	3.00	670	4.20	1,290
.90	65	2.00	310	3.10	715		
1.00	80	2.10	340	3.20	760		
1.10	95	2.20	370	3.30	805		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 15 discharge measurements made during 1906 and 1907 and is well defined.

Monthly discharge of Pecos River near Pecos, Tex., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	1,200	225	531	32,600	A.
February	805	212	337	18,700	A.
March	610	20	185	11,400	A.
April	30	3	12.3	732	B.
May	110	3	29.9	1,840	A.
June	925	6	231	13,700	A.
The period				79,000	

Discharge measurements of Margueretta flume near Pecos, Tex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 21	W. A. Lamb	20	9.3	0.71	[a] 14.4
March 29	do	20	52	2.55	125
April 29	do	20	39	1.90	67
May 16	do	20	43	2.12	57

[a] Channel obstructed by sand bar and drift.

Daily gage height, in feet, of Margueretta flume near Pecos, Tex., for 1907.

[Lawrence Vaneter, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	0.4	0.4	2.3	2.5	1.9	2.0	16	0.4	0.4	2.6	2.3	2.3	2.7
2	.4	.4	2.3	2.6	1.9	2.2	17	.4	.4	2.7	2.2	2.4	2.7
3	.4	.4	2.3	2.6	1.85	2.2	18	.4	.6	2.7	2.2	2.4	2.6
4	.4	.4	2.3	2.6	1.8	2.2	19	.4	.6	2.7	2.1	2.4	2.5
5	.4	.4	2.3	2.5	1.8	2.2	20	.4	.6	2.7	2.1	2.4	2.5
6	.4	.5	2.15	2.4	1.8	2.2	21	.4	.7	2.7	2.1	2.5	2.6
7	.4	.5	2.0	2.3	1.7	2.5	22	.4	.7	2.7	2.1	2.5	2.7
8	.4	.5	2.2	2.3	1.7	2.7	23	.4	.7	2.7	2.2	2.7	2.8
9	.4	.5	2.2	2.2	1.7	2.6	24	.4	.7	2.7	2.3	2.5	2.7
10	.4	.5	2.2	2.1	1.4	2.5	25	.4	.7	2.7	2.4	2.5	2.7
11	.4	.5	2.2	2.1	1.3	2.4	26	.4	.7	2.6	2.4	2.4	2.7
12	.4	.5	2.2	2.1	1.4	2.4	27	.4	1.0	2.5	2.4	2.4	2.5
13	.4	.6	2.5	2.1	1.4	2.4	28	.4	1.8	2.5	2.3	2.1	2.6
14	.4	.6	2.6	2.3	1.4	2.55	29	.4	.....	2.5	2.1	2.0	2.7
15	.4	.6	2.6	2.3	2.0	2.7	30	.4	.....	2.5	2.0	2.0	2.65
							31	.4	.....	2.5	.....	2.0	.....

Rating tables for Margueretta flume near Pecos, Tex.

JANUARY 1, 1907, TO FEBRUARY 27, 1907.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	2	0.80	19
.50	6	.90	25
.60	10	1.00	31
.70	14		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during the above period and the shape of previous low-water curves. It is only approximate.

EFBRUARY 28, 1907, TO APRIL 30, 1907.

1.80	59	2.30	102
1.90	67	2.40	111
2.00	75	2.50	120
2.10	84	2.60	130
2.20	93	2.70	140

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period. It is only approximate.

MAY 1, 1907, TO MAY 15, 1907.

[Indirect method for shifting channels used.]

MAY 16, 1907, TO JUNE 30, 1907.

2.00	49	2.50	89
2.10	56	2.60	98
2.20	64	2.70	108
2.30	72	2.80	118
2.40	80		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on one discharge measurement made during the above period and the form of the preceding curve. It is only approximate.

Daily discharge, in second-feet, of Margueretta flume near Pecos, Tex., May 1–15, 1907.

Day.	May.	Day.	May.	Day.	May.	Day.	May.
1	65	5	51	9	40	13	23
2	64	6	50	10	26	14	23
3	58	7	42	11	22	15	50
4	53	8	41	12	24		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Margueretta flume near Pecos, Tex., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	2	2	2.00	123	D.
February	59	2	10.3	572	D.
March	140	75	117	7,190	C.
April	130	75	99.7	5,930	B.
May	108	22	59.7	3,670	C.
June	118	49	91.1	5,420	D.
The period				22,900	

PECOS RIVER NEAR MOORHEAD, TEX.

The station, which was established by the International Boundary Commission in April, 1900, is near Moorhead, immediately above the high bridge of the Southern Pacific Railroad.

The station is in the bottom of a canyon about 300 feet deep. Both banks are of rock, but the bottom of the stream is mud. The river here consists of a series of pools connected by rapids. The best pool was chosen for the station. Frequent discharge measurements are made to determine closely the daily discharge. The highest known flood occurred April 6, 1900, about two weeks before this gage was established. The water marks showed that it reached 35.75 feet on the gage.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Pecos River near Moorhead, Tex., in 1907.

[By E. E. Winter, D. J. Smith, I. P. Whitis, and W. H. Dodd.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	727	1.65	555	June 20	760	2.0	718
January 8	728	1.6	533	June 23	624	.9	437
January 12	734	1.6	524	June 28	601	.8	408
January 16	728	1.6	543	July 5	690	.9	285
January 21	735	2.3	603	July 12	651	.6	230
January 25	726	1.75	584	July 17	659	.6	253
January 29	715	1.6	518	July 22	658	.55	250
February 8	719	1.7	651	July 26	657	.55	251
February 12	681	1.55	536	July 31	657	.55	271
February 15	671	1.45	525	August 3	642	.45	246
February 18	706	1.7	604	August 9	642	.45	251
February 22	711	1.7	619	August 13[a]	652	.65	260
February 26	684	1.55	521	August 17	638	.45	280
March 4	685	1.4	484	August 22	619	.45	270
March 8	698	1.7	524	August 24	637	.4	252
March 12	696	1.6	531	August 29	627	.4	257
March 16	686	1.55	498	September 6	666	.4	250
March 20	675	1.4	474	September 9	643	.4	251
March 25	661	1.3	475	September 14	649	.6	243
March 29	668	1.2	467	September 28	615	.7	180
April 3	634	1.1	467	October 3	610	.85	265
April 8	630	1.0	464	October 8	666	1.3	516
April 12	624	.95	430	October 12	706	1.5	568
April 16	610	.9	417	October 19	684	1.2	443
April 19	610	.9	413	October 24	652	1.1	407
April 24	614	.9	407	October 28	802	2.5	1,231
April 29	609	.9	434	November 6	987	4.2	2,877
May 3	626	.9	442	November 11	860	2.7	1,517
May 8	613	.9	428	November 15	790	2.3	1,108
May 13	613	.85	427	November 19	766	2.1	934
May 17	611	.8	420	November 23	752	2.0	940
May 21	605	.8	418	November 27	774	2.0	1,001
May 25	603	.8	400	December 2	782	2.15	1,005
May 29	593	.8	400	December 12	756	2.1	889
June 8	613	.8	392	December 16	741	1.9	802
June 12	597	.8	393	December 20	733	1.95	848
June 15	593	.65	387	December 28	738	1.9	831

[a] Measurement made August 13, 1907, considered too small and hence rejected.

Discharge measurements of Pecos River near Moorhead, Tex., in 1908.

[By W. H. Dodd and E. E. Winter.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 6	734	1.9	769	July 3	675	1.1	374
January 10	724	1.85	800	July 8	1,037	4.4	2,927
January 14	727	1.8	779	July 13	736	1.6	642
January 18	735	1.8	784	July 17	705	1.3	479
January 22	737	1.8	771	July 22	670	1.0	374
January 27	713	1.7	691	July 26	657	1.0	381
January 31	728	1.65	683	July 30	859	2.6	1,366
February 4	706	1.6	619	August 4	815	1.6	666
February 8	701	1.6	617	August 8	813	1.5	635
February 13	711	1.6	631	August 12	793	1.4	621
February 17	694	1.4	520	August 17	798	1.6	697
February 21	692	1.35	497	August 21	811	1.7	731
February 26	671	1.3	470	August 25	808	1.7	727
March 2	660	1.25	463	August 29	861	1.85	919
March 6	666	1.2	462	September 3	902	2.8	1,416
March 11	652	1.05	421	September 8	887	2.1	1,203
March 16	669	1.1	413	September 12	900	2.5	1,288
March 19	642	1.05	373	September 16	811	1.7	800
March 23	645	1.0	379	September 20	744	1.1	563
March 28	656	.95	346	September 24	731	1.2	576
April 4	638	.9	316	September 28	710	1.0	391
April 9	637	.9	329	October 3	722	1.0	369
April 13	641	.95	340	October 8	822	2.3	905
April 17	642	.95	351	October 13	717	1.0	350
April 21	765	1.55	665	October 17	683	.9	347
April 25	673	1.1	477	October 21	727	1.0	382
April 28	642	.95	353	October 25	714	1.0	380
May 4	684	.95	375	October 29	713	1.0	378
May 8	674	.9	343	November 3	708	.95	389
May 12	676	.85	339	November 7	692	.9	394
May 16	653	.85	329	November 11	696	.9	393
May 20	671	.9	345	November 16	694	.9	381
May 25	727	1.2	434	November 20	682	.9	373
May 29	646	.85	326	November 24	691	.9	379
June 3	751	1.35	597	November 28	704	.9	387
June 8	702	1.0	362	December 3	710	.95	307
June 12	681	.9	313	December 8	703	1.0	308
June 16	653	.75	239	December 14	721	1.0	302
June 20	652	.75	243	December 18	716	.95	290
June 24	639	.65	209	December 23	719	1.1	396
June 28	763	1.6	670	December 29	734	1.0	359

Daily gage height, in feet, of Pecos River near Moorhead, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.05	1.5	1.4	1.15	0.9	0.8	1.75	0.5	0.4	0.8	1.9	2.1
2	1.85	1.5	1.4	1.1	.9	.8	1.6	.5	.4	.75	2.55	2.15
3	1.7	2.15	1.4	1.1	.9	.8	1.5	.45	.4	.85	3.55	2.15
4	1.65	2.35	1.4	1.1	.9	.8	1.35	.45	.4	1.25	3.7	2.1
5	1.6	2.2	1.4	1.0	.9	.8	1.0	.45	.4	1.6	3.9	2.1
6	1.6	1.95	1.4	1.0	.9	.8	.9	.45	.4	1.6	4.2	2.1
7	1.6	1.8	1.4	1.0	.9	.8	.9	.45	.4	1.45	4.05	2.1
8	1.6	1.7	1.7	1.0	.9	.75	1.35	.45	.4	1.3	3.9	2.05
9	1.6	1.7	1.8	1.0	.9	.8	.95	.45	.4	1.35	3.6	2.05
10	1.6	1.65	1.8	.95	.9	.8	.75	.45	.4	1.55	2.8	2.05
11	1.6	1.6	1.7	.95	.9	.8	.6	.85	.4	1.6	2.8	2.0
12	1.6	1.55	1.6	.95	.85	.8	2.45	.85	.6	1.55	2.6	2.1
13	1.6	1.5	1.6	.95	.85	.75	.9	.75	.6	1.4	2.45	2.0
14	1.6	1.5	1.6	.9	.85	.75	.95	.45	.6	1.35	2.4	2.0
15	1.6	1.45	1.7	.9	.8	.75	.75	.45	.6	1.25	2.3	1.95
16	1.6	1.45	1.55	.9	.8	.7	.6	.45	.6	1.4	2.25	1.9
17	2.3	1.45	1.5	.9	.8	.7	.6	.45	.6	1.4	2.25	1.9
18	2.4	1.65	1.5	.9	.8	.7	.55	.45	.6	1.4	2.2	1.9
19	2.4	1.9	1.45	.9	.8	.8	.55	.45	.6	1.25	2.15	1.95
20	2.4	1.85	1.4	.9	.8	2.0	.55	.45	.6	1.2	2.1	1.95
21	2.3	1.75	1.4	.9	.8	.95	.55	.45	.6	1.2	2.5	1.95
22	2.15	1.7	1.4	.9	.8	.9	.55	.45	.6	1.2	2.25	1.95
23	1.95	1.6	1.4	.9	.8	.9	.55	.45	.9	1.15	2.0	1.9
24	1.75	1.6	1.3	.9	.8	.75	.55	.4	.9	1.1	1.95	1.85
25	1.75	1.55	1.3	.9	.8	.7	.55	.4	.9	1.35	1.9	1.85
26	1.7	1.55	1.25	.9	.8	.7	.55	.4	.8	2.45	1.9	1.8
27	1.65	1.5	1.2	.9	.8	.8	.55	.4	.8	2.45	2.15	1.85
28	1.6	1.5	1.2	.9	.8	.8	.55	.4	.7	2.5	2.2	1.9
29	1.6	.....	1.2	.9	.8	1.15	.55	.4	.7	2.75	2.15	1.9
30	1.6	.....	1.2	.9	.8	1.6	.55	.4	.7	1.7	2.1	1.9
31	1.55	.....	1.2	.....	.8	.....	.55	.4	.....	1.4	.....	1.9
1908.												
1	1.9	1.65	1.25	.9	1.05	.9	1.2	1.95	2.4	1.0	.9	1.0
2	1.9	1.65	1.25	.9	1.05	.85	1.95	1.8	2.65	1.0	.9	.95
3	1.9	1.6	1.2	.9	1.0	1.15	1.15	1.6	2.85	1.0	.95	.95
4	1.9	1.6	1.2	.9	.95	1.1	.95	1.6	2.75	1.0	.95	.95
5	1.9	1.6	1.2	.95	.95	1.1	.9	1.55	2.4	1.0	.9	.95
6	1.9	1.6	1.2	.95	.95	1.05	.9	1.7	2.3	.95	.9	1.0
7	1.9	1.6	1.2	.9	.95	1.0	10.8	1.5	2.15	1.25	.9	1.0
8	1.9	1.6	1.1	.9	.9	1.0	3.85	1.5	2.1	2.45	.9	1.0
9	1.85	1.55	1.05	.9	.9	1.0	2.7	1.4	2.05	1.7	.9	1.0
10	1.85	1.55	1.05	.95	.9	.95	2.4	1.4	2.2	1.45	.9	1.0
11	1.85	1.55	1.05	.95	.85	.95	2.2	1.3	2.45	1.2	.9	1.0
12	1.85	1.5	1.05	.9	.85	.9	2.0	1.4	2.45	1.05	.9	1.0
13	1.85	1.55	1.1	.95	.85	.9	1.7	1.6	2.15	1.0	.9	1.0
14	1.8	1.5	1.1	.95	.9	.9	1.55	1.65	1.95	1.0	.9	1.0
15	1.8	1.5	1.1	1.0	.9	.85	1.45	1.9	1.95	1.0	.9	1.0
16	1.8	1.4	1.1	.95	.85	.75	1.35	1.9	1.75	.95	.9	1.0
17	1.8	1.4	1.1	.95	.85	.75	1.3	1.65	1.65	.9	.9	.95
18	1.8	1.35	1.1	7.55	.85	.75	1.3	1.4	1.5	1.0	.9	.95
19	1.8	1.35	1.05	3.5	.9	.75	1.15	1.4	1.3	1.0	.9	1.0
20	1.8	1.35	1.0	2.3	.9	.75	1.15	1.35	1.1	1.0	.9	1.1
21	1.8	1.35	1.0	1.6	.85	.75	1.0	1.7	1.1	1.0	.9	1.1
22	1.8	1.35	1.0	1.5	.85	.7	1.0	1.7	1.0	1.0	.9	1.1
23	1.75	1.35	1.0	1.2	.9	.7	1.0	1.6	1.05	.95	.9	1.1
24	1.75	1.35	1.0	1.2	1.05	.65	1.0	1.6	1.15	1.0	.9	1.4
25	1.75	1.3	1.0	1.1	1.2	.65	1.0	1.7	1.2	1.0	.9	1.35
26	1.75	1.3	.95	1.05	1.35	.8	1.0	1.7	1.1	1.0	.9	1.15
27	1.75	1.3	.95	1.05	1.1	1.6	.95	1.7	1.1	1.0	.9	1.1
28	1.7	1.25	.95	.95	.9	1.6	.95	1.65	1.0	1.0	.9	1.05
29	1.7	1.25	.95	1.0	.85	1.15	2.25	1.85	1.0	1.0	1.0	1.0
30	1.7	.....	.95	1.0	.85	.95	2.55	1.85	1.0	.95	1.0	1.0
31	1.7	.....	.95	.....	.85	.....	2.35	1.8	.....	.9	.....	1.0

Daily discharge, in second-feet, of Pecos River near Moorhead, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	675	490	485	465	435	395	630	260	250	235	980	1,000
2	615	490	485	465	440	395	570	255	250	210	1,510	a1,010
3	570	735	485	a 465	a 440	395	530	a 245	250	a 265	2,330	995
4	a 555	810	a 485	465	440	395	470	245	250	465	2,460	965
5	540	775	485	465	440	395	a 325	245	250	640	2,630	955
6	540	705	485	465	435	390	285	250	250	640	a2,880	945
7	535	670	485	465	430	390	285	250	250	575	2,740	935
8	a 535	a 650	a 525	a 465	a 430	a 380	365	250	250	a 515	2,600	905
9	530	635	565	460	435	390	295	a 250	a 250	530	2,330	895
10	530	600	575	440	440	390	260	250	240	580	1,610	885
11	525	570	555	435	445	395	230	425	230	595	a1,610	855
12	a 525	a 535	a 530	a 430	425	a 395	a 850	425	260	a 580	1,420	a 890
13	530	525	525	430	a 425	385	295	390	250	525	1,260	845
14	535	535	520	420	430	385	310	280	a 245	505	1,210	845
15	540	a 525	545	415	420	a 385	275	280	245	465	a1,110	825
16	a 545	525	a 500	a 415	420	375	250	280	240	525	1,060	a 800
17	705	525	490	415	a 420	375	a 255	a 280	240	525	1,060	810
18	730	a 590	490	415	420	375	245	280	235	525	1,020	815
19	730	670	480	a 415	420	395	245	275	235	a 465	a 980	840
20	730	655	a 475	410	420	a 720	245	275	230	445	945	a 845
21	a 605	630	480	410	a 420	445	250	270	230	445	1,120	845
22	595	a 620	485	410	415	435	a 250	a 270	230	445	1,030	845
23	570	575	490	410	410	a 435	250	265	280	425	a 940	830
24	550	565	475	a 410	405	400	250	a 250	270	a 405	935	815
25	a 585	535	a 475	415	a 400	390	250	250	260	555	930	815
26	560	a 520	470	420	400	390	a 250	255	230	1,200	945	800
27	540	505	470	425	400	410	255	255	220	1,200	a1,060	815
28	520	505	465	430	400	a 410	260	255	a 180	a1,230	1,070	a 830
29	a 520	.....	a 465	a 435	a 400	480	265	a 255	180	1,380	1,040	830
30	520	.....	465	435	400	570	265	255	180	750	1,010	830
31	505	.....	465	.....	400	.....	a 270	255	.....	570	.....	830
1908.												
1	830	670	455	325	400	340	490	900	1,240	385	345	390
2	820	660	a 465	325	405	325	930	800	1,350	375	345	340
3	805	630	460	320	390	a 485	a 410	665	a1,440	a 370	a 390	a 305
4	795	a 620	460	a 315	a 375	430	315	a 665	1,400	370	395	300
5	780	620	460	335	370	430	295	650	1,300	370	380	295
6	a 770	620	a 460	335	365	395	295	695	1,270	350	385	315
7	780	615	460	325	360	360	11,700	635	1,220	470	a 395	310
8	795	a 615	435	330	a 345	a 360	a2,480	a 635	a1,200	a 970	395	a 310
9	790	600	420	a 330	345	360	1,530	620	1,190	650	395	310
10	a 800	605	420	340	350	335	1,300	620	1,220	540	395	310
11	800	605	a 420	340	340	335	1,130	605	1,280	435	a 390	305
12	800	590	415	330	a 340	a 315	970	a 620	a1,260	370	390	305
13	800	a 610	425	a 340	340	315	a 725	710	1,070	a 350	390	305
14	a 780	585	420	345	345	315	615	730	950	360	385	a 300
15	780	575	415	360	340	290	560	840	950	365	385	305
16	780	525	a 415	350	a 330	a 240	505	840	a 830	355	a 380	310
17	780	a 520	405	a 350	330	240	a 480	a 720	780	a 345	380	290
18	a 785	495	395	8,020	335	240	480	630	720	380	380	a 290
19	780	495	a 375	2,840	345	245	425	630	640	380	375	320
20	780	495	375	1,500	a 345	a 245	425	610	a 565	380	a 375	370
21	775	a 495	375	a 720	330	240	375	a 730	555	a 380	375	375
22	a 770	495	380	645	330	225	a 375	730	510	380	375	385
23	745	495	a 380	520	345	225	375	700	520	365	380	a 395
24	735	495	375	520	390	a 210	380	700	a 555	380	a 380	515
25	730	470	370	a 475	a 435	210	380	a 725	550	a 380	380	500
26	720	a 470	355	435	480	280	a 380	725	480	380	380	425
27	a 710	470	350	415	405	670	360	725	455	380	385	405
28	690	450	a 345	a 355	340	a 670	360	710	a 390	380	a 385	390
29	690	450	345	375	a 325	445	1,090	a 920	390	a 380	420	a 360
30	690	.....	345	375	325	345	a1,330	920	390	360	420	360
31	a 690	.....	345	.....	325	.....	1,170	870	.....	345	.....	360

a Dates of measurement.

Monthly discharge of Pecos River near Moorhead, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	730	505	574	35,286
February	810	490	595	33,064
March	575	465	496	30,496
April	465	410	434	25,825
May	445	400	421	25,904
June	570	375	415	24,724
July	630	230	324	19,894
August	425	245	275	16,909
September	280	180	239	14,202
October	1,380	210	594	36,526
November	2,880	930	1,461	86,926
December	1,010	800	869	53,445
The year	2,880	180	558	403,201
1908.				
January	830	690	767	47,157
February	670	450	553	31,815
March	465	345	404	24,833
April	8,020	315	763	45,402
May	480	325	359	22,066
June	670	210	337	20,072
July	11,700	295	1,053	64,731
August	920	610	719	44,182
September	1,440	390	889	52,899
October	970	345	409	25,150
November	420	345	384	22,869
December	515	290	347	21,332
The year	11,700	210	582	422,508

GALLINAS RIVER NEAR LAS VEGAS, N. MEX.

The station, which was established August 13, 1903, and is maintained primarily for the purpose of determining the amount of water available for diversion and storage in the San Guyjella basin about 6 miles northwest of Las Vegas, is located at Las Vegas Hot Springs, 6 miles above Las Vegas, N. Mex.

The altitude of the station is about 6,700 feet. It is below all perennial tributaries. The drainage area at the station is about 90 square miles, while the total for the river is over 600 square miles.

Very little water is diverted above the station, though practically all of the ordinary flow is used for irrigation in the valley below. The reservoir mentioned above has a capacity of about 40,000 acre-feet, and is to be used for the irrigation of 10,000 acres of land. It will be filled from the Gallinas, the Sapello, and other small streams in that vicinity. The flow of the stream at this point is not usually affected by ice conditions.

The gage was washed out on September 29, 1904, and replaced by the present rod gage on October 19, 1904. The zero of the new rod gage is 0.71 foot lower than that of the old one. Results at this station have been fairly satisfactory.

Discharge measurements of Gallinas River near Las Vegas, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	W. A. Lamb	34	21	2.08	26
April 19	do	30	26	2.25	42
May 12	do	34	46	2.65	124
May 26	do	34	37	2.35	68
June 8	do	34	40	2.48	85
June 25	do	35	23	2.12	33
August 27	V. L. Sullivan	26	10	2.00	12.7
October 7	do	4	1.3	1.70	1.3
1908.					
March 24	V. L. Sullivan	20	7.4	1.85	5.9
April 30	R. L. Cooper	30	21	2.20	[a] 41
July 15	do	23	10.3	1.85	[a] 11.7
August 13	do	26	18.5	2.10	[a] 29.3
October 30	do	.....	.....	1.60	[b] 1.0
December 15	J. B. Stewart	21.6	8.7	1.78	[c] 4.2

[a] Made by wading above gage. [b] Estimated. [c] Made by wading at regular section.

Daily gage height, in feet, of Gallinas River near Las Vegas, N. Mex., for 1907 and 1908.

[William Prager, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.95	2.0	2.0	2.1	2.5	2.6	2.0	2.3	2.3	1.9	1.7	1.8
2	1.9	2.0	2.0	2.1	2.55	2.7	2.0	2.5	2.4	1.8	1.7	1.8
3	1.95	2.0	2.0	2.1	2.6	2.7	2.0	2.4	2.35	1.8	1.7	1.8
4	2.0	2.0	2.12	2.1	2.6	2.6	2.0	2.3	2.3	1.8	1.7	1.8
5	2.0	2.0	2.05	2.1	2.6	2.6	2.1	2.25	2.25	1.8	1.7	1.8
6	2.0	2.0	2.05	2.1	2.6	2.6	2.05	2.2	2.2	1.7	1.7	1.8
7	1.95	2.0	2.05	2.1	2.55	2.55	2.0	2.15	2.2	1.7	1.75	1.8
8	1.95	2.0	2.2	2.2	2.5	2.5	2.0	2.15	2.15	1.7	1.8	1.8
9	2.0	2.0	2.1	2.2	2.5	2.5	2.0	2.15	2.1	1.7	1.8	1.8
10	2.0	2.05	2.15	2.2	2.55	2.4	2.0	2.05	2.1	1.7	1.8	1.8
11	2.0	2.05	2.05	2.25	2.55	2.4	2.0	2.0	2.1	1.7	1.8	1.8
12	1.95	2.05	2.0	2.25	2.6	2.4	2.1	2.0	2.05	1.7	1.8	1.8
13	2.0	2.0	2.0	2.3	2.6	2.35	2.0	2.0	2.0	1.7	1.8	1.8
14	2.0	2.05	2.05	2.25	2.55	2.3	2.0	2.0	2.0	1.7	1.8	1.8
15	2.0	2.0	2.15	2.25	2.5	2.3	1.95	2.0	2.0	1.7	1.8	1.8
16	2.0	2.0	2.0	2.2	2.5	2.2	1.95	2.0	2.0	1.7	1.8	1.8
17	2.0	2.0	2.0	2.2	2.45	2.2	2.16	1.9	2.0	1.7	1.8	1.8
18	2.05	2.0	2.05	2.2	2.4	2.2	2.0	1.95	2.0	1.7	1.8	1.8
19	2.05	2.0	2.1	2.2	2.4	2.3	2.0	1.95	2.0	1.7	1.8	1.8
20	2.0	2.0	2.2	2.1	2.4	2.3	2.15	2.15	2.0	1.7	1.8	1.8
21	2.0	2.0	2.2	2.15	2.5	2.25	2.0	2.15	1.95	1.7	1.8	1.8
22	2.0	2.0	2.3	2.4	2.5	2.2	2.0	2.1	1.9	1.6	1.8	1.8
23	2.0	2.0	2.25	2.3	2.5	2.2	2.1	2.0	1.9	1.6	1.8	1.8
24	2.0	2.0	2.25	2.3	2.5	2.2	2.15	2.0	1.9	1.7	1.8	1.8
25	2.0	2.0	2.2	2.35	2.4	2.1	2.1	2.0	1.9	1.7	1.8	1.8
26	2.0	2.0	2.2	2.3	2.4	2.1	2.15	2.0	1.9	1.7	1.8	1.8
27	2.0	2.0	2.2	2.3	2.35	2.1	2.35	2.0	1.9	1.7	1.8	1.8
28	2.0	2.0	2.2	2.3	2.3	2.1	2.2	2.0	1.9	1.7	1.8	1.8
29	2.0	.....	2.1	2.4	2.4	2.0	2.35	2.0	1.9	1.7	1.8	1.8
30	2.0	.....	2.1	2.4	2.4	2.0	2.35	2.15	1.9	1.7	1.8	1.8
31	2.0	.....	2.1	.....	2.55	.....	2.3	2.2	.....	1.7	.....	1.8
1908.												
1	1.8	1.7	2.0	1.9	2.2	2.0	1.75	2.45	2.1	1.8	1.6	1.8
2	1.8	1.7	1.8	1.9	2.2	2.0	1.7	2.75	2.1	1.7	1.6	1.8
3	1.8	1.7	1.8	1.8	2.2	2.0	1.7	2.8	2.1	1.7	1.6	1.8
4	1.8	1.7	1.8	1.8	2.2	1.95	1.75	2.65	2.05	1.7	1.6	1.8
5	1.8	1.7	1.8	1.8	2.15	1.9	1.85	2.5	2.0	1.7	1.6	1.8

Daily gage height, in feet, of Gallinas River near Las Vegas, N. Mex., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
6	1.8	1.75	1.8	1.8	2.1	1.9	1.75	2.35	2.0	1.7	1.6	1.8
7	1.8	1.8	[a] 2.0	1.8	2.1	1.9	1.7	2.3	2.0	1.7	1.6	1.8
8	1.8	1.8	1.85	1.8	2.1	1.9	1.7	2.55	1.95	1.7	1.6	1.8
9	1.8	1.8	[a] 2.05	1.8	2.1	1.9	1.7	2.35	1.9	1.7	1.6	1.8
10	1.8	1.8	1.9	1.9	2.1	1.8	1.7	2.2	1.9	1.6	1.6	1.8
11	1.8	1.8	1.85	1.95	2.1	1.8	1.7	2.2	1.9	1.6	1.6	1.8
12	1.8	1.8	[a] 2.0	2.0	2.05	1.8	1.7	2.15	1.9	1.5	1.6	1.8
13	1.8	1.8	[a] 2.0	2.0	2.0	1.8	1.7	2.25	1.9	1.5	1.6	1.8
14	1.8	1.8	1.85	2.0	2.0	1.8	1.75	2.4	1.9	1.5	1.6	1.8
15	1.8	1.8	1.8	2.1	2.05	1.8	1.9	2.3	1.9	1.5	1.6	1.8
16	1.8	1.8	1.8	2.1	2.1	1.8	1.9	2.35	1.9	1.5	1.65	1.8
17	1.8	1.8	1.8	2.1	2.1	1.8	1.9	2.15	1.9	1.5	1.7	1.8
18	1.8	1.8	1.8	2.1	2.1	1.8	2.2	2.1	1.9	1.5	1.7	1.8
19	1.8	1.8	1.85	2.15	2.05	1.8	2.05	2.2	1.9	1.5	1.7	1.8
20	1.8	1.8	1.9	2.3	2.0	1.8	2.1	2.4	1.9	1.5	1.7	1.8
21	1.8	1.8	1.9	2.35	2.0	1.75	2.0	2.2	1.9	1.5	1.7	1.8
22	1.8	1.8	1.9	2.5	2.0	1.7	1.95	2.6	1.8	1.6	1.7	1.8
23	1.8	1.8	1.9	2.5	2.1	1.7	1.9	2.3	1.8	1.6	1.7	1.8
24	1.75	[a] 2.05	1.9	2.45	2.1	1.7	1.9	2.25	1.8	1.6	1.7	1.8
25	1.7	1.8	1.9	2.35	2.1	1.7	1.9	2.2	1.8	1.6	1.7	1.8
26	1.7	1.8	1.9	2.3	2.1	[b] 2.15	1.9	2.15	1.8	1.6	1.7	1.8
27	1.7	1.8	1.9	2.25	2.05	1.85	2.0	2.1	1.8	1.6	1.7	1.8
28	1.7	[a] 2.10	1.9	2.2	2.0	1.8	1.9	2.35	1.8	1.6	1.8	1.8
29	1.7	2.20	1.9	2.2	2.0	1.8	1.9	2.35	1.8	1.6	1.8	1.8
30	1.7	.....	1.9	2.0	2.0	1.8	2.05	2.3	1.8	1.6	1.8	1.8
31	1.7	.....	1.9	.....	2.0	.....	2.65	2.2	.....	1.6	.....	1.8

[a] Fluctuations in February and March, 1908, marked (a) due to discharge from Aqua Pura Company's dam into river.

[b] Cloudburst. Gage height 2 a. m.,=3.5 feet.

Rating tables for Gallinas River near Las Vegas, N. Mex.

JANUARY 1, 1907, TO APRIL 24, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	0.0	2.10	25	2.60	113
1.70	1.3	2.20	39	2.70	135
1.80	3.5	2.30	55	2.80	158
1.90	7.0	2.40	73		
2.00	14	2.50	92		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on 14 discharge measurements made during 1907 and 1908 and is well defined.

APRIL 25, 1908, TO SEPTEMBER 3, 1908.

1.60	0.8	1.90	13	2.20	41
1.70	4	2.00	20	2.30	55
1.80	8	2.10	29		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made during 1907 and 1908 and is fairly well defined. Above gage height 2.30 feet use 1907 table.

SEPTEMBER 4, 1908, TO DECEMBER 31, 1908.

1.50	0.0	1.80	5.0	2.10	29
1.60	0.3	1.90	10.5		
1.70	1.8	2.00	19		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and 1909 and is well defined.

Monthly discharge of Gallinas River near Las Vegas, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	20	7	13.6	836	C.
February	20	14	14.9	828	C.
March	55	14	27.6	1,700	B.
April	73	25	43.5	2,590	B.
May	113	55	91.3	5,610	A.
June	135	14	64.0	3,810	A.
July	64	10.5	24.7	1,520	B.
August	92	7	27.3	1,680	B.
September	73	7	22.8	1,360	B.
October	7	0	1.68	103	
November	3.5	1.3	3.02	180	
December	3.5	3.5	3.50	215	
The year	135	0	28.2	20,400	
1908.					
January	3.5	1.3	2.97	183	
February	39	1.3	5.62	323	
March	20	3.5	7.07	435	
April	92	3.5	29.4	1,750	B.
May	41	20	27.5	1,690	B.
June	35	4	10.7	637	B.
July	124	4	15.6	959	B.
August	158	29	64.8	3,980	A.
September	29	5	12.2	726	B.
October	5	0	.74	46	
November	5	.3	1.34	80	
December	5	5	5.0	307	
The year	158	0	15.2	11,100	

NOTE.—No accuracy indicated for mean monthly discharge less than 10 second-feet; these months are in general roughly approximate.

HONDO RESERVOIR INLET NEAR ROSWELL, N. MEX.

This station which has been maintained by the United States Reclamation Service for the purpose of determining the amount of water going into the Hondo reservoir, has been known as the "inlet canal" at Hondo reservoir, N. Mex. It is located 12 miles southwest of Roswell, just below the sand check at the lower end of the inlet canal (Pl. III, *B*). It was established on August 7, 1906, and gage observations were discontinued on March 31, 1908. The reservoir is to store water for the irrigation of about 10,000 acres of land.

On August 7, 1906, the gage was moved and the present vertical-rod gage was established at a different datum. This gage is fastened to the east end of the first partition from the east end of the sand-check gate, and the zero rests on the sill of the gate.

Sufficient discharge measurements have not been made at this station to form the basis for very reliable estimates of the daily discharge. As there was practically no flow in Hondo River during the entire season of 1908, there was very little inflow at the reservoir.

Discharge measurements of Hondo reservoir inlet near Roswell, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	W. A. Lamb	33	18	0.20	[a] 28
January 23	do	56	57	.50	[a] 177
November 20	Freeman and Boscoe	34	38	.10	[a] 48

[a] Made by wading below gage.

Daily gage height, in feet, of Hondo reservoir inlet near Roswell, N. Mex., for 1907 and 1908.

[John F. Boscoe, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.30	0.35							0.40		0.30	0.05
2	.30	.38							.10		.30	.05
3	.32	.30							.10		.30	.05
4	.28	.30						0.05	.05		.25	.05
5	.22	.30							.10		.25	.05
6	.18	.25							.08		.20	.05
7	.20	.20							.08		.20	.05
8	.15	.25							.05		.20	.05
9	.18	.20							.05		.05	.05
10	.25	.12									.05	.05
11	.30	.12									.05	
12	.30	.15									.05	
13	.25	.15					0.15				.05	
14	.30	.15					.08				.05	
15	.25	.10									.05	
16	.28	.05							.15		.05	
17	.80	.05							.15		.05	
18	1.00	.05							.10		.05	
19	1.00	.05							.05		.08	
20	1.00	.05					.10		.10		.08	
21	.75	.05				0.05	.02	.10	.05	0.02	.05	
22	.58	.05						.10	.08	.05	.05	
23	.50	.00				.05	.12	.05	.05	.05	.05	
24	.50	.00				.05	.02	.02		.05	.05	.05
25	.50									.05	.05	.05
26	.45							.15		.10	.05	.05
27	.50						.10	.18		.10	.05	.05
28	.40						.20	.30		.10	.05	.05
29	.38						.15	.50		.40	.05	.05
30	.30						.20	.50		.30	.05	.05
31	.25						.08	.45		.30		.05

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1908.			1908.			1908.		
1	0.05		11	0.05		21		
2	.05		12	.05		22		
3	.05		13			23		
4	.05		14			24		
5	.20	0.20	15			25		
6	.20	.30	16			26		
7	.05		17			27		
8	.05		18			28		
9	.05		19			29		
10	.05		20			30		
						31		

NOTE.—The canal was dry on days when the gage was not read.

HONDO RIVER BELOW HONDO RESERVOIR OUTLET CANAL, NEAR ROSWELL, N. MEX.

This station was established about December 1, 1907, at the bridge across Hondo River, a short distance below the outlet canal of the Hondo reservoir, near Roswell, N. Mex., for the purpose of determining the amount of water passing the reservoir. A temporary gage was set up and gage readings were made from January 1 to March 31, 1908, at which date the station was discontinued.

There was probably no flow during December, 1907, and very little in Hondo River during the entire season of 1908, consequently no water went into the Hondo reservoir.

Daily gage height, in feet, of Hondo River below Hondo reservoir outlet canal, Roswell N. Mex., for 1908.

[John F. Boscoe, observer.]

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1			11	0.9	1.1	21	1.0	
2			12	1.0	1.1	22	1.0	
3			13	1.0	1.1	23	1.0	0.9
4		0.95	14	1.0	.9	24	1.0	.3
5		.9	15	1.0	.9	25	1.0	.3
6	0.9	1.1	16	1.0	.9	26	1.0	.3
7	1.0	1.1	17	1.0	.9	27	1.0	.3
8	.9	1.1	18	1.0	.9	28	.9	.3
9	.9	1.1	19	1.0	.9	29	.9	
10	.9	1.1	20	1.0	.9	30	.3	
						31		

NOTE.—The canal was dry on days when the gage was not read, from January 1 to March 31.

PENASCO RIVER NEAR DAYTON, N. MEX.

This station was established September 12, 1905, about 2 miles east and 1 mile north of Dayton, N. Mex., and about 1 mile above the mouth of the river. Daily gage observations were discontinued March 31, 1908, but one or two gage observations were made during the remainder of 1908 when there was water in the stream.

The records show the amount of water which the Penasco contributes to Pecos River, and are used by the United States Reclamation Service in connection with the Carlsbad project. The station is below all tributaries. The drainage area is about 1,300 square miles.

Ice conditions have little effect on stream flow in this locality.

The datum of the gage has remained constant during the maintenance of the station. Sufficient discharge measurements have not been made from which to work up estimates of daily discharge. Fair results, however, can be obtained if frequent measurements are taken. The discharge at high water gage heights has not been defined by discharge measurements.

Discharge measurements of Penasco River near Dayton, N. Mex., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 20	W. A. Lamb	23	14.0	1.28	[a] 25
March 27	do	3	.45	.93	.4

[a] Made by wading 30 feet below gage.

Daily gage height, in feet, of Penasco River near Dayton, N. Mex., for 1907 and 1908.

[Lemo Weddle, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.3	1.3	1.0	1.0	0.9	0.7	0.4	.....	.....	.....	0.7	1.0
2	1.3	1.3	1.0	1.0	.9	.7	.4	.....	.....	.....	.7	1.0
3	1.3	1.4	1.0	.9	.9	.6	.4	.....	.....	.....	.6	1.0
4	1.3	1.4	1.0	.9	.9	.6	.4	.....	.....	.....	.5	1.0
5	1.3	1.4	1.0	.9	.8	.6	.4	.....	.....	.....	.4	1.0
6	1.3	1.4	1.0	.8	.8	.6	.3	.....	.....	.....	.3	1.0
7	1.3	1.3	1.0	.8	.8	.6	.3	.....	.....	.....	.3	1.0
8	1.2	1.3	1.0	.8	.8	.6	.8	.....	.....	.....	.3	1.0
9	1.2	1.3	1.0	.9	.8	.6	.8	.....	.....	.....	.3	1.0
10	1.3	1.3	1.0	.9	.8	.6	.7	.....	.....	.....	.3	1.0
11	1.3	1.3	1.0	.9	.8	.6	.6	.....	.....	.....	.4	1.0
12	1.3	1.2	1.0	.9	.7	.6	.5	.....	.....	.....	1.0	1.0
13	1.3	1.2	.9	.9	.7	.5	.4	.....	.....	.....	1.0	1.0
14	1.3	1.1	.9	.8	.7	.5	.4	.....	.....	.....	1.0	1.0
15	1.3	1.2	1.0	.8	.7	.6	.4	.....	.....	.....	1.0	1.0
16	1.3	1.3	1.0	.8	.9	.6	.4	.....	.....	.....	1.0	1.0
17	1.3	1.3	1.0	.8	.7	.6	.....	.....	.....	.....	1.0	1.0
18	1.4	1.3	1.0	.8	.7	.6	.....	.....	.....	.....	1.0	1.0
19	1.4	1.4	1.0	.8	.7	.6	.....	.....	.....	.....	1.0	1.0
20	1.5	1.2	1.0	.8	.7	1.5	.....	.....	.....	.....	1.0	1.0
21	1.5	1.3	1.0	.9	.7	1.0	.....	.....	.....	.....	1.0	1.0
22	1.5	1.3	1.0	.8	.7	.9	.....	.....	.....	.....	1.0	1.0
23	1.5	1.3	1.0	.9	.7	.9	.....	.....	.....	.....	1.0	1.0
24	1.5	1.2	.9	.9	.7	.8	.....	.....	.....	.....	1.0	.8
25	1.5	1.2	.9	.9	.7	.8	.....	.....	.....	.....	1.0	.8
26	1.5	1.3	.9	.9	.7	.8	.....	.....	.....	.....	1.0	.....
27	1.5	1.2	.9	.9	.7	.8	.....	.....	.....	.....	1.0	.....
28	1.5	1.1	.9	.9	.7	.4	.....	.....	.....	.....	1.0	.....
29	1.5	.....	.9	.9	.8	.4	.....	.....	.....	2.1	1.0	.....
30	1.4	.....	1.0	.9	.7	.5	.....	.....	.....	1.5	1.0	.....
31	1.4	.....	1.0	.....	.7	.....	.....	.....	.....	.8	.....	.....

NOTE.—River was dry July 17–October 27 and December 26, 1907–March 31, 1908.

The following gage heights in feet were observed in 1908: July 20, 1.8; July 21, 1.6; July 22, 1.1; July 23, 1.6; Aug. 5, 1.4. The stream was practically dry during the entire season of 1908, except for one or two occasional freshets.

LAKE MCMILLAN AT LAKEWOOD, N. MEX.

During part of 1907 gage readings were taken showing the height of the water in the McMillan reservoir. After July 13 it contained very little water.

Daily gage height, in feet, of Lake McMillan at Lakewood, N. Mex., for 1907.

[H. C. Halcomb, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1....	17.4	15.3	15.6	13.5	15.1	15.9	14.8	16....	14.4	15.9	14.0	13.7	16.2	16.8	.....
2....	17.6	15.5	15.4	13.6	15.2	16.3	14.7	17....	14.8	16.1	13.9	13.6	16.2	16.4	.....
3....	17.8	15.7	14.3	13.6	15.3	16.2	14.4	18....	15.1	16.3	13.9	13.6	16.3	16.2	.....
4....	17.9	16.0	13.8	13.6	15.4	16.1	14.1	19....	15.4	16.4	13.9	13.6	16.2	16.0	.....
5....	17.9	16.2	13.9	13.6	15.5	16.0	13.7	20....	15.7	16.6	13.8	13.6	16.0	16.0	.....
6....	18.0	16.4	14.0	13.6	15.6	15.9	13.5	21....	16.0	16.7	13.8	13.7	15.8	16.0	.....
7....	18.0	16.5	14.0	13.6	15.8	15.9	12.9	22....	16.3	16.8	13.8	13.9	15.7	15.5	.....
8....	17.9	16.7	14.1	13.6	16.0	15.9	12.6	23....	16.6	16.9	13.7	14.1	15.6	15.6	.....
9....	17.5	16.9	14.1	13.6	16.0	15.9	12.3	24....	16.8	17.0	13.7	14.3	15.6	15.5	.....
10....	16.9	16.5	14.1	13.6	16.1	16.1	12.0	25....	17.0	17.1	13.6	14.5	15.5	15.3	.....
11....	16.3	16.0	14.0	13.7	16.2	16.5	11.9	26....	16.5	16.8	13.6	14.6	15.7	15.2	.....
12....	15.6	15.5	14.0	13.7	16.3	16.5	11.5	27....	16.0	16.3	13.5	14.7	15.6	15.2	.....
13....	14.7	15.5	14.0	13.7	16.2	16.6	10.6	28....	15.4	15.8	13.5	14.9	15.6	15.1	.....
14....	13.9	15.8	14.0	13.7	16.2	16.7	.....	29....	14.5	.....	13.4	15.0	15.7	15.0	.....
15....	13.9	15.8	14.0	13.7	16.2	16.7	.....	30....	14.8	.....	13.4	15.0	15.8	14.9	.....
								31....	15.1	.....	13.4	.....	15.8	.....	.....

NOTE.—July 14–December 31, 1907, reservoir nearly empty.

DEVILS RIVER AT DEVILS RIVER, TEX.

This station, which was established in April, 1900, by the International Boundary Commission, is opposite the Southern Pacific Railroad station at Devils River.

The river is about 50 miles long, has a perennial flow, and during flood periods is subject to great fluctuations. No good location for a gaging station exists on this stream where it would be accessible from the railroad station. The right bank is the talus of a cliff, the left bank is a bottom heavily timbered. At the site chosen the bed of the stream is nearly all a rock ledge, but seamed and faulted so as to be rough. The current changes in such a way as to give materially different discharges for the same gage height. It is therefore necessary to make frequent measurements to determine closely the daily flow.

The highest water on record occurred April 6, 1900, about two weeks before this gage was established. It reached a height of 25.4 feet on the gage, but this is 8 feet higher than any other known flood. Low water is 2 feet on the gage.

The observations at this station during 1907–8 have been made under the direction of the United States section of the International Boundary Commission.

Discharge measurements of Devils River at Devils River, Tex., in 1907.

[By E. E. Winter, D. J. Smith, I. P. Whitis, and W. H. Dodd.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 9	492	2.6	718	July 5	407	2.5	502
January 14	485	2.6	689	July 11	405	2.45	555
January 22	483	2.6	684	July 20	405	2.5	546
January 30	483	2.6	678	July 29	393	2.5	550
February 9	486	2.6	676	August 4	395	2.5	551
February 16	481	2.6	651	August 14	371	2.4	520
February 23	481	2.6	638	August 25	371	2.4	521
February 28	483	2.6	623	August 30	371	2.4	523
March 10	474	2.6	653	September 7 [a]	331	2.4	463
March 18	468	2.55	609	September 12	341	2.4	509
March 27	465	2.55	593	September 29	345	2.4	525
March 31	464	2.55	571	October 4	374	2.5	606
April 9	462	2.5	567	October 13	335	2.4	523
April 13	458	2.5	550	October 22	370	2.4	593
April 20	456	2.5	529	October 30	507	2.6	723
April 25	455	2.5	534	November 12	378	2.4	606
April 30	455	2.5	533	November 16	380	2.4	582
May 9	454	2.5	543	November 25	379	2.4	631
May 14	449	2.45	499	November 29	360	2.4	610
May 22	448	2.45	483	December 3	375	2.4	594
June 9	442	2.45	523	December 10	361	2.4	568
June 16	443	2.45	507	December 18	341	2.35	532
June 24	457	2.5	523	December 30	322	2.3	512
June 30	448	2.45	496				

[a] Measurement September 7, 1907, too small; hence rejected.

Discharge measurements of Devils River at Devils River, Tex., in 1908.

[By W. H. Dodd and E. E. Winter.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	329	2.3	491	July 23	389	2.4	579
January 12	335	2.3	513	July 31	397	2.55	707
January 21	338	2.3	502	August 5	398	2.5	597
January 29	346	2.3	523	August 13	405	2.5	601
February 2	325	2.25	494	August 18	386	2.45	554
February 11	335	2.3	504	August 26	363	2.4	533
February 22	338	2.25	501	August 30	365	2.4	529
February 28	322	2.25	494	September 9	363	2.4	530
March 3	324	2.3	504	September 13	362	2.4	520
March 13	327	2.3	518	September 21	347	2.35	493
March 20	318	2.25	492	September 25	344	2.3	473
March 30	321	2.25	487	September 29	342	2.3	470
April 6	321	2.25	491	October 10	337	2.3	444
April 14	328	2.3	515	October 18	342	2.35	481
April 22	386	2.5	686	October 26	371	2.4	541
April 29	371	2.4	649	October 30	346	2.35	494
May 6	350	2.35	534	November 4	335	2.3	472
May 13	343	2.35	520	November 12	337	2.3	466
May 26	460	2.8	829	November 17	334	2.3	471
May 30	419	2.6	655	November 29	367	2.45	554
June 4	402	2.5	630	December 4	335	2.3	474
June 13	390	2.45	614	December 9	337	2.3	469
June 21	380	2.4	597	December 15	334	2.3	472
June 29	362	2.35	536	December 20	332	2.3	475
July 5	388	2.4	565	December 26	336	2.3	484
July 10	875	3.95	2,209	December 30	331	2.3	479
July 14	396	2.5	592				

Daily gage height, in feet, of Devils River at Devils River, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.65	2.6	2.55	2.5	2.45	2.5	2.4	2.45	2.4	2.4	3.0	2.4
2	2.65	2.6	2.55	2.5	2.45	2.5	2.6	2.45	2.4	2.4	2.75	2.4
3	2.65	2.6	2.6	2.5	2.45	2.45	2.5	2.45	2.4	2.4	2.9	2.4
4	2.65	2.6	2.6	2.5	2.45	2.45	2.5	2.45	2.4	2.55	2.75	2.4
5	2.65	2.6	2.6	2.5	2.45	2.45	2.45	2.45	2.4	3.3	2.6	2.4
6	2.6	2.6	2.6	2.5	2.45	2.45	2.4	2.45	2.4	2.4	2.6	2.4
7	2.6	2.6	2.6	2.5	2.45	2.45	2.4	2.45	2.4	2.4	2.6	2.4
8	2.6	2.6	2.6	2.5	2.6	2.45	2.65	2.45	2.4	2.4	2.55	2.4
9	2.6	2.6	2.6	2.5	2.6	2.45	2.5	2.45	2.4	2.4	2.55	2.4
10	2.6	2.6	2.6	2.5	2.5	2.45	2.45	2.45	2.4	2.4	2.4	2.4
11	2.6	2.6	2.6	2.5	2.5	2.45	2.4	2.4	2.4	2.4	2.4	2.4
12	2.6	2.6	2.6	2.5	2.5	2.45	2.55	2.4	2.4	2.4	2.4	2.4
13	2.6	2.6	2.6	2.5	2.5	2.45	2.6	2.4	2.4	2.4	2.4	2.4
14	2.6	2.6	2.55	2.5	2.45	2.45	2.7	2.4	2.4	2.4	2.4	2.4
15	2.6	2.6	2.55	2.5	2.45	2.45	2.7	2.4	2.4	2.5	2.4	2.4
16	2.6	2.6	2.55	2.5	2.45	2.45	2.7	2.4	2.4	2.5	2.4	2.4
17	2.6	2.6	2.55	2.5	2.45	2.45	2.65	2.4	2.4	2.5	2.4	2.4
18	2.6	2.6	2.55	2.5	2.45	2.45	2.5	2.4	2.4	2.5	2.4	2.35
19	2.6	2.6	2.55	2.5	2.45	2.45	2.5	2.4	2.4	2.5	2.4	2.35
20	2.6	2.6	2.55	2.5	2.45	2.55	2.5	2.4	2.4	2.4	2.4	2.35
21	2.6	2.6	2.55	2.5	2.45	2.65	2.5	2.4	2.4	2.4	2.4	2.35
22	2.6	2.6	2.55	2.5	2.45	2.5	2.5	2.4	2.4	2.4	2.4	2.35
23	2.6	2.6	2.55	2.5	2.45	2.5	2.5	2.4	2.4	2.4	2.4	2.35
24	2.6	2.6	2.55	2.5	2.45	2.5	2.5	2.4	2.4	2.4	2.4	2.35
25	2.6	2.6	2.55	2.5	2.45	2.5	2.4	2.4	2.4	2.4	2.4	2.35
26	2.6	2.6	2.55	2.5	2.45	2.45	2.4	2.4	2.4	2.4	2.4	2.3
27	2.6	2.6	2.55	2.5	2.45	2.45	2.4	2.4	2.4	2.4	2.55	2.3
28	2.6	2.6	2.55	2.5	2.45	2.45	2.45	2.4	2.4	2.4	2.6	2.3
29	2.6	.....	2.55	2.5	2.45	2.45	2.5	2.4	2.4	2.5	2.45	2.3
30	2.6	.....	2.55	2.5	2.65	2.45	2.45	2.4	2.4	2.75	2.4	2.3
31	2.6	.....	2.55	.....	2.5	.....	2.45	2.4	.....	2.4	.....	2.3
1908.												
1	2.3	2.3	2.3	2.25	2.4	2.7	2.35	2.5	2.4	2.3	2.3	2.4
2	2.3	2.25	2.3	2.25	2.4	2.6	2.35	2.45	2.35	2.3	2.3	2.3
3	2.3	2.25	2.3	2.25	2.4	2.5	2.35	2.4	2.35	2.3	2.3	2.3
4	2.3	2.25	2.3	2.25	2.4	2.5	2.35	2.4	2.35	2.35	2.3	2.3
5	2.3	2.3	2.3	2.25	2.4	2.5	2.4	2.5	2.35	2.35	2.3	2.3
6	2.3	2.3	2.3	2.25	2.4	2.5	2.4	2.7	2.35	2.35	2.3	2.3
7	2.3	2.25	2.3	2.25	2.35	2.5	2.4	4.0	2.4	2.45	2.3	2.3
8	2.3	2.25	2.3	2.25	2.35	2.5	2.45	2.75	2.4	2.4	2.3	2.3
9	2.3	2.3	2.3	2.25	2.35	2.5	3.5	2.6	2.4	2.3	2.3	2.3
10	2.3	2.3	2.3	2.25	2.35	2.5	3.9	2.55	2.4	2.3	2.3	2.3
11	2.3	2.3	2.3	2.25	2.35	2.5	3.0	2.5	2.4	2.3	2.3	2.3
12	2.3	2.3	2.3	2.4	2.35	2.45	2.65	2.5	2.4	2.3	2.3	2.3
13	2.3	2.3	2.3	2.35	2.35	2.45	2.5	2.5	2.4	2.3	2.3	2.3
14	2.3	2.3	2.3	2.3	2.35	2.45	2.5	2.5	2.4	2.3	2.3	2.3
15	2.3	2.3	2.3	2.3	2.35	2.45	2.5	2.5	2.4	2.35	2.3	2.3
16	2.3	2.3	2.25	2.3	2.35	2.4	2.45	2.5	2.4	2.35	2.3	2.3
17	2.3	2.3	2.25	2.3	2.35	2.4	2.45	2.45	2.4	2.35	2.3	2.3
18	2.3	2.3	2.25	2.35	2.35	2.4	2.45	2.45	2.4	2.35	2.3	2.3
19	2.3	2.3	2.25	2.4	2.35	2.4	2.45	2.45	2.4	2.35	2.3	2.3
20	2.3	2.25	2.25	2.75	2.35	2.4	2.5	2.5	2.4	2.35	2.3	2.3
21	2.3	2.25	2.25	2.65	2.35	2.4	2.5	2.55	2.35	2.35	2.3	2.3
22	2.3	2.25	2.25	2.5	2.35	2.4	2.5	2.5	2.35	2.35	2.3	2.3
23	2.3	2.3	2.25	2.5	2.35	2.4	2.45	2.45	2.35	2.35	2.3	2.3
24	2.3	2.3	2.25	2.5	4.2	2.4	2.4	2.4	2.3	2.3	2.3	2.3
25	2.3	2.3	2.25	2.5	3.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3
26	2.3	2.3	2.25	2.5	2.8	2.4	2.4	2.4	2.3	2.4	2.3	2.3
27	2.3	2.3	2.25	2.45	2.7	2.4	2.4	2.4	2.3	2.35	2.3	2.3
28	2.3	2.25	2.25	2.4	2.7	2.35	2.4	2.4	2.3	2.35	2.4	2.3
29	2.3	2.25	2.25	2.4	2.7	2.35	2.45	2.4	2.3	2.35	2.45	2.3
30	2.3	.....	2.25	2.4	2.65	2.35	2.5	2.4	2.3	2.35	2.4	2.3
31	2.3	.....	2.25	.....	2.7	.....	2.55	2.4	.....	2.35	.....	2.3

Daily discharge, in second-feet, of Devils River at Devils River, Tex., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	695	675	605	570	520	545	465	525	520	525	1,050	600
2	700	675	605	570	520	545	560	530	520	525	855	600
3	705	675	635	570	520	525	510	535	520	525	980	a 595
4	710	675	635	570	520	525	505	a 535	520	a 645	865	590
5	715	675	640	570	520	525	a 475	535	520	1,250	745	585
6	700	675	645	570	520	525	465	535	515	560	750	580
7	705	675	645	570	520	525	480	535	a 515	555	755	580
8	710	675	650	565	630	525	620	535	515	550	715	575
9	a 715	a 675	650	a 565	a 630	a 525	555	535	515	545	715	570
10	710	675	a 655	565	540	525	545	535	510	540	600	a 570
11	705	675	650	560	540	520	a 530	520	510	535	605	570
12	700	670	650	555	540	520	600	520	a 510	530	a 605	570
13	695	665	645	a 550	540	515	620	520	510	a 525	600	570
14	a 690	660	620	550	a 500	515	665	a 520	510	530	595	570
15	690	655	615	545	500	510	660	520	510	620	590	565
16	690	a 650	615	545	495	a 505	660	520	510	625	a 585	565
17	690	650	610	540	495	505	630	520	515	635	585	565
18	685	650	a 610	535	490	505	550	520	515	645	590	a 530
19	685	645	605	530	490	505	545	520	515	650	595	535
20	685	645	605	a 530	485	545	a 545	520	515	580	600	535
21	685	640	605	530	485	585	545	520	520	585	605	535
22	a 685	640	600	530	a 485	525	545	520	520	a 595	610	535
23	685	a 640	600	530	485	525	545	520	520	590	615	535
24	685	635	600	535	480	a 525	550	520	520	585	620	540
25	685	635	600	a 535	480	525	500	a 520	520	580	a 630	540
26	680	630	595	535	480	500	500	520	520	575	625	505
27	680	625	a 595	535	475	500	500	520	525	570	740	505
28	680	a 625	590	535	475	495	525	520	525	565	775	505
29	680	.....	585	535	475	495	a 550	525	a 525	645	a 650	510
30	a 675	.....	575	a 535	670	a 495	525	a 525	525	845	605	a 510
31	675	.....	a 570	.....	545	.....	525	525	.....	565	.....	510
1908.												
1	510	525	500	485	635	740	535	645	530	465	470	520
2	500	a 495	500	485	620	685	535	585	510	465	470	480
3	a 490	490	a 505	485	605	630	535	520	510	460	470	480
4	495	490	505	490	590	a 630	535	510	510	480	a 470	a 475
5	495	520	505	490	575	630	a 565	a 595	510	475	470	475
6	495	515	510	490	a 560	630	565	800	510	470	470	475
7	500	480	510	a 490	535	630	565	2,260	530	510	470	470
8	500	475	510	490	530	630	620	850	530	485	470	470
9	505	510	515	490	530	630	1,730	700	a 530	445	470	a 470
10	505	505	515	490	525	630	a 2,160	650	530	a 445	470	470
11	510	a 505	515	490	525	630	1,150	600	525	445	465	470
12	a 515	505	520	565	520	615	760	600	525	450	a 465	470
13	510	510	a 520	540	a 520	a 615	590	a 600	a 520	450	465	470
14	510	515	520	a 515	520	615	a 590	600	520	450	465	470
15	510	515	515	515	515	615	590	600	520	475	470	a 470
16	510	520	495	515	515	595	585	600	520	475	470	470
17	510	520	495	515	510	595	585	555	520	480	a 470	475
18	505	525	495	545	510	595	585	a 555	520	a 480	470	475
19	505	530	495	575	505	595	585	555	520	485	470	475
20	505	495	a 490	785	505	595	590	600	520	490	470	a 475
21	a 500	500	490	745	500	a 595	590	650	a 495	495	470	475
22	505	a 500	490	a 685	500	590	590	600	495	500	470	475
23	510	535	490	685	500	585	a 585	555	495	505	470	480
24	510	535	490	685	2,550	580	580	535	475	490	470	480
25	515	535	490	685	1,570	575	580	535	a 475	495	470	485
26	515	530	490	685	a 830	565	580	a 535	475	a 540	470	a 485
27	520	530	485	665	740	560	580	535	475	515	470	485
28	525	a 495	485	650	740	540	580	535	470	505	525	485
29	a 525	495	485	a 650	740	a 535	620	530	a 470	500	a 555	480
30	525	.....	a 485	650	a 695	535	665	a 530	470	a 495	525	a 480
31	525	.....	485	.....	740	.....	a 705	530	.....	495	.....	480

a Dates of measurement.

Monthly discharge of Devils River at Devils River, Tex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
January	715	675	693	42,595
February	675	625	657	36,466
March	655	570	616	37,894
April	570	530	549	32,648
May	670	475	518	31,835
June	585	495	520	30,952
July	665	465	548	33,709
August	535	520	525	32,271
September	525	510	517	30,774
October	1,250	525	606	37,279
November	1,050	585	682	40,572
December	600	505	553	34,017
The year	1,250	465	582	421,012
1908.				
January	525	490	508	31,259
February	535	475	510	29,355
March	520	485	500	30,744
April	785	485	574	34,175
May	2,550	500	676	41,564
June	740	535	606	36,079
July	2,160	535	697	42,863
August	2,260	510	647	39,769
September	530	470	507	30,159
October	540	445	481	29,583
November	555	465	476	28,314
December	520	470	477	29,345
The year	2,550	445	555	403,209

RIO SALADO NEAR GUERRERO, TAMAULIPAS, MEXICO.

The Salado is a torrential stream, entering the Rio Grande from the Mexican side about 60 miles below Laredo, or 730 miles by river below El Paso. The town of Guerrero is located on the Salado some 4 miles above its mouth, and the gaging station is 2 miles above the town. The gaging station was established in 1900 by the International Boundary Commission.

The river is a series of pools and rapids. The best pool available was chosen for the station. The banks are sandy clay, not subject to erosion. The bottom is mud. In low water the river is measured by wading among the rocks below the station. Frequent discharge measurements are made to determine closely the daily flow. The highest recorded flood, on June 16, 1903, gave 17.7 on the gage.

The observations at this station have been made under the direction of the Mexican section of the International Boundary Commission.

Discharge measurements and gage heights for the years 1900 to 1904, which have not hitherto been published by the United States Geological Survey, are given herewith, together with data for 1907 and 1908.

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Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1900.

[By C. Treviño.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 27	914	2.45	382	December 30	924	2.5	393

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1901.

[By C. Treviño and D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec. ft.*		*Sq. ft.*	*Feet.*	*Sec. ft.*
January 2	829	2.4	268	July 7	505	0.8	120
January 6	806	2.3	287	July 11	598	1.0	162
January 10	795	2.2	280	July 15	437	.1	94
January 14	776	2.1	226	July 19	388	— .2	55
January 18	735	2.15	242	July 23	348	— .4	42
January 21	740	2.0	211	July 27	327	— .6	37
January 24	702	1.9	202	August 3	296	— .8	31
January 27	666	1.8	171	August 7	254	—1.0	25
February 1	661	1.7	180	August 11	236	—1.1	24
February 5	666	1.75	185	August 15	233	—1.1	24
February 9	657	1.5	173	August 19	221	—1.2	*a* 00
February 13	663	1.45	158	August 23	199	—1.4	*a* 00
February 17	645	1.3	141	August 27	185	—1.5	*a* 00
February 21	583	1.2	117	September 3	1,425	3.6	1,824
February 25	587	1.1	112	September 7	781	2.3	325
March 1	564	1.0	99	September 11	891	2.8	499
March 5	562	.9	94	September 14	463	.5	88
March 9	553	1.1	101	September 17	438	.4	83
March 13	525	.6	88	September 21	363	— .1	48
March 17	561	.55	87	September 25	329	— .4	55
March 21	491	.45	75	September 29	676	2.3	273
March 25	457	.2	63	October 3	569	1.5	136
March 28	441	.15	56	October 7	666	2.1	239
April 1	423	.1	54	October 10	640	2.0	205
April 5	429	.05	48	October 13	1,332	5.7	3,042
April 9	396	— .1	47	October 18	582	1.6	162
April 13	369	— .2	41	October 21	561	1.5	142
April 17	327	— .3	33	October 23	950	4.0	1,445
April 21	304	— .5	30	October 25	1,065	4.8	2,068
April 25	304	— .6	35	October 28	1,033	4.5	1,587
April 28	318	— .75	41	November 1	976	4.2	1,191
May 1	289	— .7	36	November 4	961	4.1	1,220
May 9	2,510	9.22	11,526	November 8	918	3.7	988
May 13	1,100	3.15	861	November 12	855	3.4	792
May 17	1,015	2.85	600	November 16	818	3.2	643
May 21	1,210	3.85	1,118	November 20	782	3.0	521
May 25	1,427	4.72	1,936	November 23	760	2.9	466
May 29	1,108	3.32	802	November 27	713	2.7	391
June 1	955	2.55	560	November 29	1,157	4.85	2,371
June 4	1,148	3.52	1,322	December 2	693	2.6	354
June 8	772	1.85	525	December 6	649	2.3	264
June 12	729	1.7	373	December 10	618	2.1	239
June 16	650	1.3	182	December 14	595	2.0	167
June 20	597	1.0	149	December 18	578	1.9	153
June 24	519	.7	113	December 22	574	1.8	163
June 29	1,826	6.35	5,160	December 26	576	1.8	163
July 3	730	2.2	293	December 30	560	1.7	150

a No flow August 19, 23, and 27, 1901.

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1902.

[By D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	542	1.5	132	July 15	178	— 1.0	[c]0
January 7	533	1.5	127	July 19	167	— 1.1	[c]0
January 11	522	1.4	117	July 23	155	— 1.2	[c]0
January 15	516	1.4	111	July 26	143	— 1.3	[c]0
January 19	504	1.3	85	July 28	555	+ 1.9	127
January 23	484	1.2	73	July 29	1,009	4.2	747
January 27	462	1.1	[a]167	August 2	438	1.1	59
January 31	466	1.1	62	August 6	296	.1	24
February 4	447	1.0	65	August 11	244	— .4	18
February 8	456	1.1	82	August 15	218	— .6	12
February 12	475	1.1	85	August 19	193	— .8	[c]0
February 16	466	1.0	61	August 23	174	— 1.0	[c]0
February 20	470	1.0	73	August 28	163	— 1.1	[c]0
February 24	455	.9	58	September 1	150	— 1.2	[c]0
February 28	439	.8	103	September 5	137	— 1.3	[c]0
March 4	397	.6	51	September 8	672	2.05	271
March 8	376	.4	46	September 9	910	3.3	792
March 12	359	.3	42	September 14	601	1.7	165
March 17	335	.0	29	September 19	430	.6	86
March 21	311	— .2	26	September 20	1,860	7.75	7,198
March 26	308	— .2	27	September 24	753	2.5	352
March 30	296	— .3	23	September 28	542	1.4	164
April 3	276	— .5	21	September 30	918	3.4	917
April 7	263	— .6	10	October 2	1,619	6.7	4,884
April 11	249	— .8	0	October 6	872	3.0	716
April 15	1,214	4.75	[b]2,222	October 11	620	1.7	154
April 20	589	1.9	212	October 15	1,883	7.6	6,955
April 25	485	1.2	115	October 16	2,666	11.1	14,257
April 29	420	.8	74	October 19	879	3.0	585
May 3	371	.5	48	October 23	662	1.5	168
May 7	988	3.9	1,360	October 27	553	.9	70
May 10	786	3.3	697	November 1	504	.5	61
May 14	603	2.2	259	November 5	478	.4	55
May 19	453	1.1	70	November 6	755	2.1	254
May 24	536	1.5	136	November 9	638	1.4	148
May 28	395	.8	73	November 14	510	.6	69
June 2	306	.2	35	November 18	447	.2	41
June 5	252	— .2	32	November 22	418	.0	27
June 9	251	— .4	20	December 2	883	2.85	513
June 13	226	— .6	10	December 4	1,410	5.35	2,942
June 17	198	— .8	[c]0	December 6	914	3.1	596
June 21	183	— .9	[c]0	December 10	688	1.8	188
June 23	579	2.0	200	December 15	576	1.1	81
June 25	447	1.1	78	December 20	502	.6	58
June 29	304	.0	30	December 24	472	.4	55
July 8	226	— .7	8	December 28	446	.2	34
July 11	204	— .8	[c]0				

[a] Measurement, January 27, 1902, rejected.
[b] Measurement, April 15, 1902, made by floats.
[c] June 17, 21, July 11, 15, 19, 23, 26, August 19, 23, 28, September 1, 5, 1902; no flow.

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1903.

[By D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-feet.*		*Sq. ft.*	*Feet.*	*Sec.-feet.*
January 2	410	0.0	25	July 31	2,719	7.4	6,841
January 6	30	— .1	[a] 8	August 2	3,241	9.75	11,242
January 10	29	— .2	[a] 6	August 7	1,728	2.7	424
January 16	735	2.0	[a] 207	August 11	1,995	4.7	1,876
January 21	473	.4	[a] 60	August 15	1,452	2.0	259
January 25	414	.0	[a] 25	August 17	1,896	4.2	1,483
January 29	31	— .1	[a] 9	August 19	1,668	2.95	463
February 2	30	— .2	[a] 7	August 24	1,468	2.1	278
February 6	29	— .3	[a] 6	August 28	1,291	1.4	[b] 319
February 10	29	— .3	[a] 6	September 2	1,271	1.3	153
February 14	29	— .4	[a] 6	September 6	1,245	1.1	142
February 18	29	— .4	[a] 5	September 12	1,483	2.3	343
February 22	29	— .4	[a] 5	September 16	1,291	1.3	156
February 28	29	— .4	[a] 5	September 19	1,887	4.5	1,719
May 8	590	1.3	143	September 24	1,456	2.3	346
May 20	442	.5	187	September 29	1,303	1.5	315
May 23	396	.2	132	October 2	1,745	3.85	1,164
May 24	844	2.95	559	October 7	1,495	3.0	636
May 26	661	1.9	211	October 10	1,552	3.0	620
May 29	541	1.1	145	October 14	1,413	2.5	412
June 1	536	1.1	100	October 18	1,344	2.1	296
June 3	874	3.1	682	October 22	1,277	1.9	231
June 7	610	1.6	137	October 26	1,240	1.6	179
June 11	790	2.7	483	October 30	1,354	2.2	345
June 13	2,040	8.6	10,005	November 3	1,224	1.5	178
June 15	3,431	14.25	20,220	November 7	1,193	1.4	162
June 23	2,411	5.6	2,792	November 11	1,137	1.1	136
June 27	2,294	5.0	2,297	November 15	1,108	1.0	123
June 30	2,282	5.0	2,172	November 19	82	.8	[a] 66
July 4	2,123	4.3	1,391	November 23	107	.9	[a] 128
July 6	2,498	6.1	4,634	December 7	17	.5	[a] 14
July 7	2,706	7.05	6,065	December 11	16	.5	[a] 14
July 11	2,006	4.0	1,224	December 15	15	.5	[a] 14
July 15	1,950	3.7	906	December 19	15	.5	[a] 14
July 19	1,867	3.3	575	December 23	17	.6	[a] 16
July 23	1,795	3.0	473	December 27	16	.5	[a] 15
July 28	2,190	5.05	2,455				

[a] Measurement made by wading at rocks January 6 to February 28, and November 19 to December 27, 1903.

[b] Strong wind up stream August 28, 1903. Measurement rejected.

NOTE.—No records available for March and April, 1903.

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1904.

[By D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq.-ft.	*Feet.*	*Sec.-ft.*		*Sq.-ft.*	*Feet.*	*Sec.-ft.*
January 1	90	0.9	[b]67	June 22	72	0.30	[a]43
January 5	90	.7	[a]65	June 27	71	.20	[a]41
January 9	91	.7	[a]64	July 1	65	— .1	[a]16
January 13	81	.6	[a]56	July 5	67	.0	[a]21
January 21	16	.5	[a]16	July 9	67	.0	[a]21
January 25	15	.4	[a]15	July 13	64	— .3	[a]15
February 1	73	.4	[a]45	July 29	102	.8	85
February 5	72	.4	[a]44	August 2	66	.0	[a]19
February 9	73	.5	[a]47	August 6	63	— .3	[a]16
February 13	82	.7	[a]60	August 14	1,066	1.6	206
February 17	75	.5	[a]49	August 18	1,107	1.0	124
February 22	71	.3	[a]44	August 22	72	.2	[a]40
February 26	71	.3	[a]43	August 25	72	.3	[a]45
March 1	67	.1	[a]33	August 29	66	.0	[a]19
March 5	68	.0	[a]21	September 2	63	— .3	[a]15
March 9	65	— .1	[a]15	September 7	2,134	7.0	6,148
March 13	64	— .2	[a]15	September 11	2,333	8.1	8,142
March 17	63	— .3	[a]13	September 20	2,409	7.9	6,111
March 21	63	— .3	[a]13	September 24	2,654	9.0	8,089
March 25	61	— .4	[a]11	September 28	2,272	7.2	5,123
March 29	61	— .4	[a]11	October 2	2,500	6.6	4,848
April 3	1,110	1.0	121	October 6	2,385	6.4	4,392
April 6	1,385	2.4	338	October 10	3,313	6.1	3,890
April 10	1,111	1.0	122	October 14	2,276	5.9	3,591
April 14	72	.3	[a]43	October 18	2,227	5.7	3,236
April 18	68	.1	[a]34	October 23	2,194	5.6	2,955
April 23	63	— .3	[a]14	October 28	2,194	5.6	2,986
April 27	61	— .4	[a]13	November 2	2,229	5.8	3,287
May 1	61	— .4	[a]13	November 6	2,102	5.2	2,442
May 4	2,598	8.05	7,964	November 10	2,039	5.0	2,174
May 8	1,005	1.0	111	November 14	2,022	4.9	2,038
May 12	1,156	1.2	142	November 18	1,977	4.7	1,974
May 16	2,633	8.55	8,752	November 22	1,932	4.5	1,660
May 20	1,408	3.4	776	November 27	2,056	5.1	2,320
May 24	1,109	1.9	255	December 1	1,950	4.7	1,811
May 28	973	1.3	201	December 6	1,912	4.4	1,578
June 1	1,034	1.60	234	December 10	1,871	4.2	1,442
June 6	2,800	9.45	11,249	December 15	1,879	4.1	1,385
June 10	1,418	3.50	809	December 19	1,844	3.9	1,174
June 14	1,081	1.70	200	December 24	1,843	3.9	1,159
June 18	92	.90	[a]70	December 28	1,808	3.7	967

[a] Measurements made by wading at rocks below station.

NOTE.—River dry July 14–28, 1904.

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1907.

[By D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	1,884	3.9	816	July 6	1,867	4.1	839
January 6	1,892	3.8	742	July 10	1,630	3.2	573
January 10	1,845	3.7	740	July 14	1,494	2.5	357
January 14	1,842	3.7	748	July 18	1,511	2.6	390
January 18	1,818	3.6	675	July 22	1,477	2.4	400
January 22	1,806	3.6	671	July 26	1,451	2.3	371
January 26	1,775	3.5	604	July 29	1,438	2.2	335
January 29	1,772	3.5	594	August 2	1,350	2.1	297
February 2	1,770	3.5	606	August 6	1,313	1.9	258
February 6	1,782	3.4	601	August 10	1,290	1.8	235
February 10	1,775	3.3	584	August 14	1,266	1.7	216
February 14	1,764	3.3	571	August 18	1,227	1.5	185
February 18	1,728	3.2	544	August 22	1,196	1.3	184
February 22	1,723	3.1	511	August 26	1,163	1.1	164
February 26	1,702	3.0	489	August 29	1,152	1.0	160
March 2	1,653	2.9	439	September 2	30	.8	20
March 6	1,661	2.8	429	September 6	29	.7	13
March 10	1,638	2.7	407	September 10	26	.5	9
March 14	1,618	2.6	386	September 14	25	.4	9
March 18	1,608	2.5	353	September 18	24	.3	8
March 22	1,639	2.4	423	September 22	24	.3	7
March 26	1,643	2.3	425	September 25	1,590	2.8	383
March 29	1,654	2.2	341	September 27	1,452	2.1	350
April 2	1,627	2.1	307	October 2	1,298	1.5	196
April 6	1,595	2.0	284	October 6	1,246	1.3	185
April 10	1,591	2.0	282	October 7	2,868	9.45	9,607
April 15	1,570	1.9	267	October 8	3,311	10.8	13,159
April 19	1,572	1.9	267	October 10	1,793	4.4	884
April 23	1,543	2.2	388	October 14	1,587	3.4	582
April 27	1,450	1.8	254	October 18	1,527	3.1	504
May 2	1,467	1.8	259	October 22	1,628	3.6	644
May 6	1,657	2.8	442	October 26	1,842	4.6	907
May 10	2,079	3.9	865	October 29	1,737	4.2	768
May 13	1,959	4.3	1,216	November 2	1,801	4.6	1,686
May 17	1,559	2.3	394	November 6	2,001	5.4	2,135
May 21	1,503	2.0	283	November 10	1,928	5.2	1,897
May 25	1,505	2.0	289	November 15	1,862	4.9	1,795
May 27	2,295	6.0	2,847	November 19	1,830	4.7	1,782
May 29	1,748	3.3	556	November 25	1,784	4.5	1,295
June 2	1,463	1.8	260	November 27	1,766	4.4	1,232
June 6	1,373	1.4	213	December 2	1,747	4.5	1,204
June 11	1,339	1.1	194	December 6	1,755	4.5	1,209
June 15	1,285	1.0	178	December 10	1,672	4.4	1,104
June 19	1,502	2.0	289	December 14	1,694	4.3	1,033
June 24	1,731	3.6	662	December 19	1,669	4.2	959
June 27	1,631	3.1	383	December 23	1,669	4.2	969
July 2	1,577	2.8	352	December 28	1.651	4.1	900
July 4	2,561	7.5	5,834				

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1908.

[By D. de Lassaulx.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 2	1,631	4.0	834	July 10	1,165	2.1	168
January 6	1,601	3.9	783	July 14	1,727	4.6	1,438
January 12	1,566	3.7	732	July 18	1,115	2.0	156
January 16	1,539	3.6	625	July 22	72	1.4	*a* 59
January 20	1,523	3.5	581	July 26	123	1.7	*a* 75
January 24	1,503	3.4	544	July 30	141	2.1	*a* 124
January 28	1,485	3.3	515	August 3	1,648	4.4	1,130
February 2	1,492	3.1	391	August 7	1,485	3.7	596
February 6	1,467	3.0	362	August 8	1,962	6.0	2,792
February 10	1,467	3.0	356	August 11	2,079	5.8	3,203
February 15	1,429	2.8	318	August 15	1,783	5.0	1,774
February 19	1,411	2.7	292	August 19	1,742	4.9	1,519
February 23	1,391	2.6	268	August 23	1,762	5.3	1,953
February 27	1,370	2.5	249	August 27	1,603	4.5	1,146
March 2	1,352	2.4	243	September 2	1,465	4.2	927
March 6	1,323	2.3	234	September 6	1,419	4.0	816
March 10	1,323	2.3	232	September 10	1,386	3.8	665
March 14	1,305	2.2	219	September 15	1,656	5.2	1,910
March 18	1,273	2.0	200	September 18	1,555	4.8	1,707
March 22	1,280	2.0	201	September 22	1,265	3.6	501
March 24	1,526	3.2	442	September 27	1,227	3.4	439
March 28	1,372	2.4	258	October 2	1,180	3.3	334
April 2	1,272	1.9	194	October 6	1,176	3.3	347
April 6	1,249	1.8	182	October 8	2,281	7.3	5,931
April 11	2,034	5.8	2,746	October 10	1,418	4.4	1,141
April 15	1,802	4.6	1,717	October 14	1,133	3.2	257
April 19	1,601	3.5	575	October 18	1,129	3.2	256
April 23	1,701	4.2	883	October 22	1,082	3.0	179
April 27	1,517	3.1	494	October 23	1,860	6.2	3,442
May 2	1,362	2.6	273	October 26	1,133	3.3	289
May 6	1,281	2.2	237	October 29	1,033	2.9	153
May 10	1,224	1.9	217	November 3	1,044	2.9	153
May 15	1,908	5.6	2,586	November 7	1,031	2.9	146
May 19	1,495	3.0	468	November 11	1,002	2.7	133
May 23	1,305	2.1	221	November 15	1,019	2.9	143
May 28	1,112	1.3	173	November 19	1,000	2.7	135
June 2	1,486	3.7	566	November 23	994	2.7	136
June 6	1,339	2.2	203	November 27	1,014	2.7	133
June 10	1,169	1.6	178	December 2	995	2.6	125
June 14	1,095	1.2	164	December 6	987	2.6	124
June 18	1,059	1.0	156	December 10	983	2.6	123
June 23	29	.7	*a* 16	December 14	979	2.6	128
June 27	1,324	2.4	259	December 18	956	2.5	119
July 2	64	.9	*a* 29	December 22	950	2.5	118
July 5	1,207	2.2	179	December 26	951	2.5	120
July 7	1,839	4.95	1,627	December 30	948	2.5	119

a Measurement made by wading at rocks below station June 23, July 2, 22 to 30, 1908.

Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1900 to 1904, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.[a]												
1					6.35	5.4	2.35	4.6	3.9	3.9		
2					5.4	4.1	5.35	3.7	4.55	3.8		
3					4.3	4.3	5.6	3.15	4.25	3.75		
4					3.9	4.25	4.1	3.2	4.15	3.7		
5					2.9	6.85	3.05	2.55	5.6	3.65		
6					2.6	7.7	2.7	3.3	5.3	3.6		
7					2.4	3.95	2.95	3.4	4.65	3.55		
8					2.3	3.6	2.55	4.45	3.95	3.5		
9					2.15	3.25	2.35	5.2	3.8	3.5		
10					1.95	2.95	2.15	6.55	3.75	3.5		
11					1.85	2.8	2.0	7.65	3.7	3.5		
12					1.75	2.65	1.85	7.75	3.6	3.5		
13					1.7	2.55	1.75	6.85	3.55	3.45		
14					1.55	2.45	3.25	5.35	3.5	3.4		
15					1.85	2.4	4.9	4.75	3.5	3.4		
16					3.8	2.25	9.3	4.55	3.5	3.4		2.8
17					7.25	2.2	8.2	4.7	3.45	3.35		2.8
18					8.2	2.1	4.4	4.6	3.4	3.3		2.8
19					5.35	2.05	3.05	4.5	3.35	3.35		2.7
20					4.7	1.95	2.95	4.4	3.3	3.4		2.7
21					4.3	5.9	2.55	4.3	3.3	3.5		2.65
22					4.55	4.75	2.4	4.2	3.3	3.65		2.6
23					4.55	3.9	2.3	4.4	3.3	3.7		2.6
24				2.85	4.8	2.75	2.2	4.3	3.2	3.7		2.6
25				2.65	4.05	2.4	2.15	4.3	3.2	3.75		2.5
26				2.55	3.55	2.55	2.1	4.2	4.6	3.85		2.5
27				2.45	3.45	2.2	2.05	4.15	4.25	4.05		2.5
28				2.35	3.35	1.95	2.45	4.1	4.15	3.8		2.5
29				2.35	3.25	1.85	2.25	4.0	4.05	3.75		2.5
30				3.6	3.15	1.7	4.55	4.0	4.0	3.7		2.5
31					3.05		4.9	3.9		3.7		2.45
1901.[b]												
1	2.4	1.7	1.0	.1	— .7	2.52	2.7	— .7	1.55	1.65	4.2	2.6
2	2.4	1.7	1.0	.1	7.65	2.42	2.1	— .8	1.6	1.5	4.1	2.55
3	2.4	1.65	1.0	.1	4.7	2.32	2.1	— .8	4.0	1.7	4.1	2.45
4	2.4	1.6	1.0	.1	3.4	4.18	1.6	— .8	4.7	2.25	4.05	2.4
5	2.3	1.75	.9	.05	2.85	3.05	1.22	— .9	5.35	2.3	4.0	2.3
6	2.3	1.6	1.1	.0	3.15	2.15	.95	— .9	2.7	2.2	3.9	2.25
7	2.3	1.5	1.1	— .1	3.45	1.95	.75	— .95	2.3	2.15	3.8	2.2
8	2.3	1.5	1.1	— .1	4.9	1.82	.6	— .9	2.15	2.1	3.7	2.2
9	2.3	1.5	1.05	— .1	9.05	1.95	.8	—1.0	1.75	2.05	3.6	2.1
10	2.2	1.5	.95	— .2	5.85	2.0	1.2	—1.0	1.55	2.0	3.5	2.1
11	2.2	1.5	.75	— .2	4.6	1.82	1.0	—1.1	2.35	2.0	3.4	2.05
12	2.2	1.45	.6	— .2	3.7	1.65	.65	—1.1	1.2	2.0	3.35	2.0
13	2.2	1.4	.6	— .25	3.15	1.52	.35	—1.1	.85	4.45	3.3	2.0
14	2.15	1.4	.6	— .3	3.0	1.48	.2	—1.1	.5	3.1	3.25	1.95
15	2.2	1.4	.6	— .3	2.9	1.38	.1	—1.1	.6	2.2	3.2	1.9
16	2.1	1.4	.6	— .3	2.88	1.28	.0	—1.1	.4	1.85	3.2	1.9
17	2.1	1.3	.55	— .32	2.82	1.2	.35	—1.1	.4	1.75	3.1	1.9
18	2.1	1.3	.5	— .38	2.72	1.12	.05	—1.2	.45	1.6	3.1	1.9
19	2.1	1.3	.45	— .4	3.30	1.02	— .2	—1.2	.25	1.6	3.05	1.85
20	2.0	1.2	.4	— .4	4.5	.95	— .3	—1.2	.05	1.6	3.0	1.8
21	1.95	1.2	.4	— .5	3.7	.82	— .35	—1.25	.10	1.5	3.0	1.8
22	1.9	1.2	.3	— .5	3.1	.72	— .4	—1.3	.25	3.05	2.9	1.8
23	1.9	1.1	.25	— .62	2.85	.7	— .45	—1.4	.30	3.65	2.9	1.8
24	1.9	1.1	.2	— .6	2.72	.7	— .5	—1.4	.35	4.5	2.8	1.8
25	1.9	1.1	.2	— .6	3.95	.65	— .5	—1.4	.4	4.8	2.75	1.8
26	1.88	1.1	.2	— .6	4.7	.6	— .55	—1.4	2.6	4.65	2.7	1.8
27	1.8	1.0	.2	— .75	3.95	.65	— .6	—1.5	3.65	4.55	2.7	1.7
28	1.8	1.0	.15	— .72	4.05	2.45	— .6	—1.5	3.0	4.45	4.15	1.7
29	1.8	.....	.15	— .7	3.18	6.25	— .6	—1.5	2.3	4.35	4.3	1.7
30	1.75	.....	.15	— .7	2.85	4.12	— .7	—1.5	1.85	4.3	3.0	1.65
31	1.7	.....	.12	.....	3.15	.....	— .7	—1.5	.....	4.2	.....	1.6

[a] Gage heights for 1900 complete as far as Mexican records exist. [b] No flow August 19–31, 1901.

Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.[a]												
1	1.55	1.1	0.8	−0.4	0.6	0.25	−0.3	1.2	−1.2	2.05	0.45	4.1
2	1.5	1.1	.75	− .5	.55	.15	− .35	1.1	−1.2	6.65	.4	2.85
3	1.5	1.1	.65	− .5	.45	.05	− .4	.8	−1.3	6.2	.9	3.1
4	1.5	1.05	.6	− .5	.4	− .1	− .5	.45	−1.3	5.0	.55	5.15
5	1.5	1.1	.5	− .55	.3	− .2	− .55	.25	−1.3	4.1	.95	3.7
6	1.5	1.1	.5	− .6	4.15	− .25	− .6	.05	−1.4	2.95	2.0	3.0
7	1.5	1.1	.4	− .6	3.8	− .3	− .7	− .05	−1.4	3.5	1.65	2.8
8	1.5	1.1	.4	− .7	2.95	− .35	− .7	− .1	2.15	2.35	1.4	3.5
9	1.45	1.1	.3	− .7	3.6	− .4	− .7	− .2	3.1	2.2	1.35	2.05
10	1.4	1.1	.3	− .7	3.1	− .45	− .8	− .3	2.6	1.95	1.25	1.7
11	1.4	1.1	.3	− .8	2.55	− .5	− .8	− .4	2.1	1.65	1.05	1.5
12	1.4	1.1	.3	- .8	2.1	− .55	− .8	− .5	2.0	1.45	.85	1.5
13	1.4	1.0	.2	− .8	1.95	− .6	− .9	− .5	2.0	1.25	.75	1.4
14	1.4	1.0	.2	−3.65	2.05	− .65	− .9	− .55	1.6	2.1	.6	1.25
15	1.4	1.0	.1	4.85	1.65	− .7	−1.0	− .6	1.45	8.0	.5	1.1
16	1.4	1.0	.0	4.05	1.4	− .75	−1.0	− .7	1.05	10.6	.4	1.0
17	1.3	1.0	.0	3.1	1.2	− .8	−1.0	− .7	.9	6.1	.3	.9
18	1.3	1.0	− .1	2.5	1.25	− .85	−1.1	− .8	.75	3.95	.2	.8
19	1.3	1.0	− .1	2.2	1.05	− .9	−1.1	− .8	.55	2.9	.2	.7
20	1.3	1.0	− .1	1.9	.8	− .9	−1.1	− .9	7.25	2.6	.1	.6
21	1.2	.9	− .2	1.95	.55	− .9	−1.2	− .9	4.7	2.05	.1	.55
22	1.2	.9	− .2	1.75	.35	−1.0	−1.2	−1.0	4.1	1.75	.0	.5
23	1.2	.9	− .2	1.55	.75	1.8	−1.2	−1.0	2.95	1.45	1.65	.4
24	1.2	.9	− .2	1.35	1.5	1.25	−1.3	−1.0	2.4	1.25	1.45	.4
25	1.2	.9	− .2	1.2	1.35	1.05	−1.3	−1.0	2.05	1.05	1.6	.3
26	1.15	.85	− .2	1.05	1.15	.7	−1.3	−1.0	1.85	1.0	2.1	.25
27	1.1	.8	− .25	.95	.95	.35	−1.3	−1.1	1.55	.9	1.7	.2
28	1.1	.8	− .3	.85	.75	.15	2.05	−1.1	1.35	.8	1.45	.2
29	1.1	.....	− .3	.8	.55	− .05	4.4	−1.1	1.2	.7	1.25	.15
30	1.1	.....	− .35	.7	.45	− .2	2.05	−1.1	4.4	.6	1.25	.1
31	1.1	.....	− .4	.....	.3	.....	1.55	−1.2	.....	.5	.....	.05
1903.[b]												
1	.0	− .2	.....	.....	2.2	.95	4.9	9.55	1.35	2.6	1.6	.6
2	.0	− .2	.....	.....	1.85	3.3	4.55	9.4	1.25	3.8	1.6	.5
3	− .05	− .2	.....	.....	1.55	2.95	4.35	5.8	1.05	3.3	1.55	.5
4	− .1	− .25	.....	.....	1.35	2.35	4.25	4.15	1.0	3.0	1.65	.5
5	− .1	− .3	.....	.....	1.15	2.2	5.75	3.35	.9	3.0	1.5	.5
6	− .1	− .3	.....	.....	1.0	1.9	6.6	3.0	1.2	3.0	1.45	.5
7	− .1	− .3	.....	.....	.9	1.5	6.75	2.65	1.1	3.3	1.35	.5
8	− .15	− .3	.....	.....	2.05	1.3	5.4	2.45	1.0	3.15	1.3	.5
9	− .2	− .3	.....	.....	2.8	1.25	4.5	2.3	.9	5.35	1.2	.5
10	− .2	− .3	.....	.....	2.1	1.5	4.15	2.2	.85	2.95	1.15	.5
11	− .2	− .3	.....	.....	3.45	2.7	3.95	4.65	2.05	2.75	1.1	.5
12	− .2	− .3	.....	.....	4.3	2.8	3.85	3.4	2.15	2.6	1.1	.5
13	− .2	− .3	.....	.....	3.2	8.85	3.75	2.8	1.45	2.5	1.0	.5
14	− .05	− .4	.....	− .6	2.45	11.8	3.7	2.2	1.05	2.45	1.0	.5
15	.1	− .4	.....	− .6	1.9	14.85	3.65	2.3	1.15	2.4	1.0	.5
16	1.75	− .4	.....	− .6	1.4	17.5	3.55	4.05	1.3	2.45	.95	.5
17	1.6	− .4	.....	− .7	1.05	14.2	3.5	4.15	1.15	2.2	.9	.5
18	1.0	− .4	.....	− .7	.85	9.15	3.4	3.65	3.25	2.1	.8	.55
19	.7	− .4	.....	− .7	.65	7.05	3.3	2.9	4.45	2.0	.75	.5
20	.45	− .4	.....	− .7	.45	6.45	3.2	3.75	3.5	1.9	.7	.5
21	.35	− .4	.....	− .8	.35	6.05	3.15	2.95	3.35	1.9	.7	.5
22	.2	− .4	.....	− .8	.25	5.75	3.1	2.4	2.8	1.85	.7	.6
23	.15	− .4	.....	− .8	1.95	5.55	3.0	2.2	2.45	1.8	.9	.6
24	.1	− .4	.....	− .9	2.85	5.35	2.95	2.1	2.25	1.75	.7	.6
25	.0	− .4	.....	− .9	2.25	5.25	2.85	2.0	2.05	1.7	.65	.5
26	.0	− .4	.....	− .9	1.85	5.3	2.8	1.65	1.9	1.6	.6	.5
27	− .05	− .4	.....	− .9	1.55	5.0	3.2	1.45	1.75	1.55	.6	.5
28	− .1	− .4	.....	2.45	1.3	4.85	4.75	1.35	1.65	2.0	.6	.5
29	− .1	.....	.....	4.0	1.05	5.5	4.2	1.25	1.5	1.95	.6	.55
30	− .1	.....	.....	2.8	.95	5.15	3.45	1.2	1.5	2.1	.6	.6
31	− .2	.....	.....	.....	1.7	.....	7.35	1.1	.....	1.85	.....	.7

[a] No flow April 8–13, June 15–22, July 11–27, and August 17–September 7, 1902.
[b] Gage heights for 1903 complete so far as Mexican records exist.

Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.[a]												
1	0.9	0.4	0.1	−0.5	−0.4	1.5	−0.1	0.1	−0.3	6.6	5.65	4.7
2	.8	.4	.1	.17	− .5	1.25	− .1	.0	− .4	6.6	5.8	4.6
3	.8	.4	.1	1.1	− .5	1.15	− .2	− .1	− .4	6.6	5.7	4.5
4	.8	.4	.0	.85	6.6	.95	− .1	− .2	− .5	6.55	5.4	4.45
5	.7	.4	.0	1.0	3.2	1.25	.0	− .3	− .5	6.5	5.3	4.4
6	.7	.4	.0	2.35	2.1	8.45	.0	− .35	− .5	6.4	5.2	4.35
7	.7	.4	.0	2.05	1.4	8.45	− .1	− .4	4.35	6.25	5.2	4.3
8	.7	.5	− .1	1.7	1.1	6.3	.0	− .4	7.9	6.2	5.1	4.3
9	.7	.55	− .1	1.3	4.0	4.25	.0	− .45	6.55	6.1	5.1	4.3
10	.65	.65	− .1	.95	1.9	3.35	− .1	− .5	7.8	6.0	5.0	4.2
11	.7	.7	− .1	.75	1.2	2.55	− .2	− .5	7.95	6.0	5.0	4.2
12	.65	.7	− .1	.55	.9	2.0	− .2	− .5	8.85	5.95	4.95	4.2
13	.6	.7	− .2	.4	.65	1.8	− .3	− .5	8.6	5.9	4.9	4.1
14	.6	.6	− .2	.3	3.4	1.65	− .3	1.75	11.0	5.85	4.8	4.1
15	.6	.6	− .3	.2	4.55	1.45	− .4	1.75	14.5	6.15	4.8	4.1
16	.6	.5	− .3	.1	8.6	1.25	− .4	1.45	13.05	6.05	4.8	4.0
17	.6	.5	− .3	.0	8.05	1.05	− .5	1.15	12.5	5.8	4.7	4.0
18	.6	.4	− .3	− .1	6.1	.9	− .5	.95	12.45	5.7	4.7	4.0
19	.6	.4	− .3	− .15	4.3	.8	− .5	.75	10.2	5.7	4.7	3.9
20	.6	.35	− .3	− .2	3.35	.65	− .6	.55	7.95	5.85	4.6	3.9
21	.5	.3	− .3	− .25	2.7	.45	− .6	.4	8.2	6.0	4.6	3.9
22	.5	.3	− .3	− .3	2.35	.3	− .6	.3	8.7	5.7	4.5	3.9
23	.5	.3	− .3	− .3	2.05	.35	− .7	.2	8.95	5.6	4.5	3.9
24	.5	.3	− .4	− .4	1.85	.45	− .7	.1	9.2	5.5	4.5	3.9
25	.4	.3	− .4	− .4	1.65	.3	− .7	.35	10.4	5.7	4.45	3.8
26	.4	.25	− .4	− .4	1.5	.3	− .8	.45	8.6	5.5	4.4	3.8
27	.4	.2	− .4	− .4	1.4	.2	− .8	.25	7.5	5.6	4.95	3.8
28	.4	.2	− .4	− .4	1.85	.15	.85	.05	7.15	5.55	5.15	3.7
29	.4	.2	− .45	− .4	2.4	.1	.7	.05	6.95	5.4	5.0	3.7
30	.4	.....	− .5	− .4	2.35	.0	.3	− .15	6.65	5.4	4.8	3.7
31	.4	.....	− .5	.....	1.9	.....	.25	− .25	.....	5.3	.....	3.7
1907.												
1	3.9	3.5	3.0	2.1	1.9	1.9	2.9	2.1	.8	1.6	4.5	4.4
2	3.9	3.5	2.9	2.1	1.95	1.75	2.8	2.1	.8	1.5	4.6	4.5
3	3.9	3.4	2.9	2.1	1.95	1.6	7.2	2.0	.8	1.4	4.75	4.5
4	3.8	3.4	2.9	2.1	2.25	1.5	8.6	2.0	.7	1.3	4.95	4.6
5	3.8	3.4	2.8	2.1	2.55	1.45	6.05	1.95	.7	1.3	5.15	4.6
6	3.8	3.4	2.8	2.1	2.7	1.4	3.95	1.9	.65	1.5	5.4	4.5
7	3.8	3.4	2.8	2.0	2.25	1.3	4.6	1.9	.6	9.9	5.3	4.5
8	3.8	3.3	2.8	2.0	1.95	1.2	3.95	1.8	.6	11.15	5.3	4.5
9	3.8	3.3	2.7	2.0	1.75	1.2	3.4	1.8	.5	5.6	5.2	4.5
10	3.7	3.3	2.7	2.0	4.8	1.2	3.2	1.8	.5	4.25	5.15	4.4
11	3.7	3.3	2.7	2.0	3.7	1.1	3.05	1.75	.5	3.85	5.0	4.4
12	3.7	3.3	2.7	1.9	3.9	1.1	2.8	1.7	.4	3.65	5.0	4.4
13	3.7	3.3	2.6	1.9	4.2	1.0	2.55	1.7	.4	3.5	4.9	4.3
14	3.7	3.2	2.6	1.9	3.45	1.0	2.45	1.65	.4	3.4	4.9	4.3
15	3.7	3.2	2.6	1.9	2.85	1.0	2.9	1.6	.4	3.3	4.9	4.3
16	3.6	3.2	2.6	1.9	2.55	.8	3.25	1.5	.4	3.2	4.8	4.3
17	3.6	3.2	2.6	1.8	2.25	.8	2.8	1.5	.4	3.2	4.8	4.3
18	3.6	3.2	2.5	1.8	2.15	1.35	2.55	1.45	.3	3.1	4.7	4.3
19	3.6	3.2	2.5	2.4	2.1	1.8	2.4	1.55	.3	3.1	4.7	4.2
20	3.6	3.1	2.5	2.7	2.0	1.55	2.4	1.55	.3	3.15	4.6	4.2
21	3.6	3.1	2.5	2.4	1.95	1.85	2.55	1.4	.3	3.35	4.6	4.2
22	3.55	3.1	2.4	2.35	2.25	1.75	2.4	1.3	.45	3.7	4.5	4.2
23	3.5	3.1	2.4	2.15	2.25	3.3	2.4	1.2	.85	4.45	4.5	4.15
24	3.5	3.0	2.4	2.0	2.05	3.6	2.4	1.1	2.3	4.6	4.4	4.1
25	3.5	3.05	2.3	1.9	1.95	3.25	2.3	1.1	2.75	4.65	4.4	4.1
26	3.5	3.0	2.3	1.9	1.9	3.1	2.3	1.1	2.35	4.65	4.4	4.1
27	3.5	3.0	2.2	1.9	5.9	3.1	2.2	1.0	2.05	4.45	4.4	4.1
28	3.5	3.0	2.2	1.8	3.85	3.0	2.2	1.0	1.85	4.35	4.3	4.05
29	3.5	.....	2.2	1.8	3.1	3.0	2.2	.95	1.7	4.2	4.3	4.0
30	3.5	.....	2.1	1.7	2.4	2.9	2.2	.9	1.75	4.15	4.2	4.0
31	3.5	.....	2.1	.....	2.05	.....	2.2	.8	.....	4.05	.....	4.0

[a] No flow July 15–27, 1904.

Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1900 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	4.0	3.2	2.4	1.9	2.7	4.25	1.0	4.15	4.2	3.3	2.9	2.6
2	4.0	3.1	2.4	1.9	2.6	3.65	.9	4.8	4.15	3.3	2.9	2.6
3	3.9	3.1	2.3	1.9	2.5	3.2	.9	4.2	4.85	3.3	2.9	2.6
4	3.9	3.1	2.3	1.9	2.4	2.55	1.9	3.75	4.2	3.2	2.8	2.6
5	3.9	3.1	2.3	1.9	2.3	2.3	2.1	3.6	4.1	3.2	2.8	2.6
6	3.9	3.0	2.3	1.8	2.2	2.2	2.75	3.8	4.0	3.3	2.8	2.6
7	3.8	3.0	2.2	1.8	2.1	1.95	5.05	3.7	3.95	3.35	2.9	2.6
8	3.8	3.0	2.2	1.8	2.0	1.75	3.95	6.15	3.9	7.0	2.8	2.6
9	3.8	3.0	2.25	1.7	1.9	1.6	2.55	6.85	3.9	5.6	2.8	2.6
10	3.7	3.0	2.3	1.7	1.9	1.6	2.1	5.5	3.8	4.05	2.7	2.6
11	3.7	2.9	2.2	5.7	1.9	1.5	2.05	5.8	3.95	3.55	2.7	2.6
12	3.7	2.9	2.1	5.7	1.8	1.4	1.65	5.25	3.85	3.4	2.7	2.6
13	3.6	2.9	2.1	5.4	1.8	1.3	1.5	5.1	3.8	3.3	3.2	2.6
14	3.6	2.8	2.2	2.85	3.4	1.2	4.35	5.1	4.4	3.2	3.05	2.6
15	3.6	2.8	2.1	4.5	6.1	1.1	3.4	5.0	4.85	3.2	2.9	2.6
16	3.6	2.8	2.2	3.95	6.2	1.1	2.8	5.0	4.0	3.1	2.9	2.6
17	3.5	2.7	2.1	3.6	4.35	1.0	2.25	4.9	4.75	3.1	2.9	2.6
18	3.5	2.7	2.0	3.45	3.35	1.0	1.9	4.9	4.6	3.15	2.8	2.5
19	3.5	2.7	2.0	3.35	2.85	.9	1.65	4.9	3.95	3.1	2.7	2.5
20	3.5	2.6	2.0	3.85	2.35	.9	1.5	4.8	3.8	3.1	2.7	2.5
21	3.5	2.6	2.0	4.2	2.25	.8	1.4	5.35	3.75	3.0	2.7	2.5
22	3.4	2.6	2.0	5.9	2.25	.8	1.6	5.85	3.65	3.15	2.7	2.5
23	3.4	2.6	2.0	4.95	2.05	.7	1.85	5.15	3.55	6.15	2.7	2.5
24	3.4	2.5	3.1	4.2	1.9	.7	1.65	4.75	3.5	3.7	2.7	2.5
25	3.4	2.5	2.8	3.55	1.8	.85	1.5	4.7	3.5	3.35	2.7	2.5
26	3.3	2.5	2.5	3.25	1.65	2.15	1.6	4.6	3.5	3.3	2.6	2.5
27	3.3	2.5	2.4	3.05	1.45	2.25	1.4	4.5	3.4	3.3	2.7	2.5
28	3.3	2.4	2.35	2.95	1.3	1.75	1.25	4.5	3.4	2.9	2.6	2.5
29	3.3	2.4	2.15	2.85	1.3	1.5	1.1	4.4	3.4	2.9	2.6	2.5
30	3.3	.....	2.05	2.75	1.2	1.15	2.2	4.35	3.4	2.9	2.65	2.5
31	3.2	.....	2.0	.....	1.2	.....	3.75	4.3	.....	2.9	.....	2.5

RIO SAN JUAN NEAR LA QUEMADA AND SANTA ROSALIA RANCH, TAMAULIPAS, MEXICO.

The San Juan is a long torrential stream entering the Rio Grande 15 miles below Roma and 790 miles by river below El Paso. Six miles above its mouth is the town of Camargo.

The station was first established in 1900 near La Quemada, 12 miles above Camargo, by the International Boundary Commission, but in time of heavy flood in the Rio Grande backwater reached the station, and on July 14, 1902, it was moved 6 miles farther upstream to its present location near Santa Rosalia ranch, Tamaulipas, Mexico. It is now above backwater.

The river bed at both stations shifts constantly and frequent discharge measurements have been made to determine closely the daily flow. Both banks are of sandy clay which are above high water and do not erode. The bottom of the river is sand which erodes slightly in flood.

Low water (no flow) is zero on the gage. The highest recorded flood, on September 16, 1904, reached 27 feet on the gage.

The observations at both stations have been made under the direction of the Mexican section of the International Boundary Commission.

Discharge measurements and gage heights, 1900 to 1904, which have not hitherto been published by the United States Geological Survey, are given herewith, together with data for 1907–8.

Discharge measurements of Rio San Juan near La Quemada, Tamaulipas, Mexico, in 1900.

[By S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 3	591	2.6	461	November 23	188	1.0	237
October 5	257	1.75	64	November 25	200	1.1	343
October 8	256	1.45	66	November 28	199	1.0	187
October 19	231	.9	14	December 4	207	1.0	371
October 23	269	1.8	89	December 10	222	1.1	449
October 28	269	1.9	89	December 14	229	1.2	478
October 30	228	1.2	51	December 18	418	3.15	1,737
November 11	181	.7	312	December 21	434	1.5	840
November 13	186	.8	117	December 26	251	1.05	418
November 16	181	.7	168	December 30	249	1.2	436
November 20	204	.95	129				

NOTE.—Discharge measurements for 1900 complete so far as Mexican records exist.

Discharge measurements of Rio San Juan near La Quemada, Tamaulipas, Mexico, in 1901.

[By S. Jaso and A. Argándar.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	263	1.2	219	July 14	474	3.2	697
January 7	272	1.3	234	July 18	363	1.5	218
January 11	272	1.25	[a] 168	July 22	314	.8	111
January 15	263	1.15	210	July 26	193	.5	40
January 20	272	1.3	228	July 30	291	.7	97
January 24	272	1.3	224	August 3	227	1.0	54
January 28	272	1.3	214	August 7	255	1.6	144
February 3	244	1.0	123	August 11	217	1.1	30
February 8	251	1.1	140	August 15	203	.8	16
February 12	251	1.05	125	August 19	194	.6	11
February 23	200	.95	92	August 23	176	.7	13
February 25	200	.9	90	August 27	173	.4	11
February 28	194	.8	74	August 31	231	1.2	44
March 3	194	.8	72	September 3	1,799	14.2	6,398
March 7	194	.8	74	September 7	393	1.8	571
March 11	189	.7	63	September 11	952	7.6	2,716
March 15	184	.6	61	September 15	319	2.1	257
March 20	174	.5	54	September 19	455	3.05	747
March 24	168	.4	48	September 23	397	2.3	394
March 28	155	.2	19	September 26	2,323	15.6	8,251
April 2	149	.1	18	September 30	887	6.25	2,430
April 6	144	.0	15	October 4	883	6.3	2,301
April 10	144	.0	16	October 8	480	3.7	1,052
April 14	144	.0	16	October 12	428	3.2	784
April 19	125	.0	14	October 16	435	3.0	675
April 23	125	.0	14	October 20	453	2.6	722
April 28 [b]	86	.0	0	October 30	798	4.3	1,787
May 5 [b]	0	.0	0	November 1	758	4.1	1,518
May 11	483	3.5	732	November 5	424	3.5	709
May 15	241	1.1	127	November 9	385	2.8	625
May 19	216	.7	75	November 13	413	2.9	766
May 24	271	1.4	151	November 17	356	2.6	442
May 27	315	2.0	397	November 21	386	2.6	492
May 31	271	1.5	160	November 25	388	2.6	454
June 5	1,531	12.6	[c] 7,097	November 29	1,483	11.7	5,302
June 9	243	1.3	134	December 3	516	3.5	1,062
June 13	217	.8	84	December 7	413	2.9	636
June 17	205	.5	60	December 11	389	2.6	550
June 21	188	.4	37	December 15	281	2.5	509
June 25	188	.4	37	December 19	351	2.3	427
June 30	2,470	19.35	[c] 15,742	December 23	368	2.5	465
July 6	372	1.8	229	December 27	343	2.3	423
July 10	1,565	10.0	[c] 7,991	December 31	354	2.4	435

[a] Measurement January 11, 1901, rejected.
[b] No flow April 28 to May 9, 1901.
[c] Measurements June 5 and 30, and July 10, 1901, made by floats.

Discharge measurements of Rio San Juan near La Quemada, Tamaulipas, Mexico, in 1902.

[By A. Argándar.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	330	2.1	274	April 10	169	0.3	10
January 9	327	2.1	308	April 14	261	1.4	139
January 12	321	2.0	275	April 17	1,463	11.5	6,439
January 16	316	2.0	277	April 22	292	1.9	203
January 22	299	1.9	216	April 26	276	1.4	161
January 26	294	1.8	205	May 3	215	.8	30
January 30	288	1.7	146	May 7	1,534	12.7	6,987
February 1	290	1.6	129	May 11	375	2.4	436
February 5	293	1.6	128	May 15	229	1.1	68
February 9	302	1.65	169	May 19	210	.8	27
February 13	304	1.7	175	May 23	241	1.2	87
February 17	309	1.7	184	May 28	196	.7	33
February 21	275	1.5	150	June 1	187	.5	27
February 25	273	1.5	166	June 5 [a]	157	.3	17
February 28	268	1.3	143	June 9	146	.2	0
March 5	238	1.1	96	June 13	145	.1	0
March 9	232	.9	54	June 17	141	.0	0
March 13	224	.85	47	June 21	137	— .1	0
March 17	210	.8	27	June 25	125	— .3	0
March 21	209	.7	22	June 29	122	.4	0
March 25	190	.6	17	July 3	103	— .5	0
March 29	188	.55	15	July 7	782	4.5	1,991
April 2	180	.5	13	July 11	375	2.7	564
April 6	174	.4	12				

[a] River dry June 6–July 5, 1902.

NOTE.—This station was moved to Santa Rosalia ranch, 6 miles upstream, July 14, 1902.

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1902.

[By A. Argándar and S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 15	252	1.3	157	October 6	397	3.4	579
July 19	128	.4	56	October 10	291	2.5	315
July 23	83	.0	28	October 14	188	1.5	146
July 27	64	— .2	7	October 16	2,494	15.35	12,539
July 29	720	5.9	2,456	October 19	473	4.4	991
July 30	2,350	16.0	9,904	October 23	294	2.8	399
August 3	823	7.0	2,822	October 27	211	2.0	223
August 7	82	.8	30	October 30	1,901	8.6	5,351
August 11	56	.5	16	November 4	177	1.6	162
August 15	46	.4	9	November 9	146	1.5	119
August 19	41	.1	5	November 13	113	1.1	57
August 23	31	.0	4	November 17	98	1.0	39
August 27 [a]	24	— .2	0	November 21	87	.8	28
August 31	22	— .3	0	November 25	229	2.15	233
September 3	11	— .3	0	November 29	96	.9	46
September 8	320	2.4	362	December 2	1,667	7.5	[b] 5,297
September 12	268	2.0	222	December 7	196	1.8	172
September 16	450	3.4	599	December 11	179	1.7	146
September 20	199	.4	35	December 16	135	1.2	85
September 24	281	1.9	225	December 20	126	1.1	78
September 28	1,725	10.9	6,832	December 23	126	1.1	82
October 1	2,471	15.05	10,818	December 28	118	1.0	68

[a] River dry August 25–September 5; also September 21 and 22, 1902.
[b] Measurement made by floats December 2, 1902.

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1903.

[By S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	233	1.9	188	September 30	365	1.9	186
June 27	194	1.5	103	October 3	327	1.5	117
July 3	203	1.6	118	October 8	287	1.1	46
July 7	783	6.2	2,215	October 13	296	1.3	65
July 11	217	1.7	147	October 18	236	.8	42
July 15	131	.8	31	October 22	227	.7	29
July 21	100	.4	6	October 26	369	1.95	193
July 25	87	.2	4	October 30	272	1.0	51
July 29	72	.0	4	November 4	260	.9	37
August 1	3,177	21.0	26,677	November 9	274	1.0	53
August 5	275	3.4	478	November 13	256	.9	39
August 10	78	1.7	79	November 19	248	.8	30
August 14	115	2.0	144	November 23	251	.8	45
August 17	3,778	24.0	30,826	November 27	252	.9	38
August 27	654	3.75	823	November 30	249	.9	33
August 31	577	3.3	580	December 5	245	.9	37
September 4	826	4.95	1,548	December 9	257	1.0	43
September 9	501	2.9	416	December 14	256	1.0	34
September 14	395	2.1	228	December 18	259	1.1	45
September 18	535	2.75	506	December 22	272	1.1	50
September 22	352	2.4	159	December 26	266	1.1	44
September 26	498	2.8	455	December 30	263	1.0	49

NOTE.—Discharge measurements for 1903 complete so far as Mexican records exist.

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1904.

[By S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	272	1.0	49	July 4	416	2.45	282
January 8	270	1.1	44	July 9	271	1.30	39
January 13	262	1.0	40	July 14	183	.5	17
January 18	265	1.0	41	July 18	158	.3	13
January 23	250	.9	26	July 22	146	.2	12
January 27	235	.8	22	July 31	254	1.1	72
February 3	239	.8	22	August 4	190	.7	38
February 6	233	.8	24	August 8	154	.4	14
February 12	225	.7	24	August 13	774	4.6	1,432
February 15	243	.8	26	August 17	492	3.0	545
February 20	318	1.7	181	August 22	211	.9	22
February 24	257	1.0	45	August 26	222	1.0	37
February 28	215	.6	19	August 30	152	.4	14
March 3	193	.5	16	September 3	130	.0	5
March 7	182	.4	*a* 8	September 7	781	4.55	1,302
March 11	180	.3	*a* 7	September 8	1,157	6.65	2,659
March 15	166	.2	*a* 7	September 9	1,680	9.3	5,209
March 19	168	.2	*a* 7	September 10	2,149	11.7	6,523
March 25	153	.1	*a* 6	September 13	2,537	13.45	9,092
March 29	391	2.05	226	September 17	4,672	24.5	37,578
April 3	2,791	18.45	*b* 12,687	September 22	2,797	15.05	9,954
April 9	308	1.4	99	September 25	1,401	6.0	2,037
April 13	246	.8	23	September 29	1,765	9.65	4,039
April 16	224	.6	20	October 3	1,026	4.95	1,482
April 21	190	.4	14	October 7	1,248	5.65	1,847
April 24	605	3.85	700	October 12	842	3.9	629
April 28	278	1.1	52	October 16	759	3.1	408
May 2	1,576	9.4	3,861	October 20	695	2.7	261
May 6	380	2.0	210	October 25	625	2.3	187
May 9	1,615	9.35	4,525	October 30	615	2.2	169
May 14	1,292	6.4	3,192	November 4	620	2.3	176
May 18	384	1.8	212	November 8	706	2.8	328
May 24	243	.9	36	November 14	696	2.8	310
May 28	230	.8	26	November 19	754	3.15	441
June 4	245	1.1	52	December 6	764	3.3	446
June 7	2,743	13.25	9,234	December 10	757	3.2	422
June 14	321	1.6	114	December 14	713	3.0	375
June 18	265	1.3	64	December 19	707	2.8	333
June 24	511	2.95	498	December 23	711	2.8	309
June 27	255	1.0	59	December 28	669	2.5	192
June 30	192	.7	21	December 31	662	2.6	211

a Approximate, March 7 to 25, 1904. *b* Made by floats, April 3, 1904.

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1907.

[By S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	397	2.85	253	July 10	766	5.0	1,534
January 8	376	2.7	222	July 11	580	3.95	815
January 13	362	2.6	206	July 13	651	4.35	946
January 17	337	2.5	172	July 15	388	2.85	280
January 22	321	2.4	165	July 19	225	1.7	65
January 25	318	2.3	158	July 23	203	1.5	48
January 28	318	2.3	157	July 26	227	1.7	50
February 2	320	2.35	162	July 29	196	1.4	29
February 8	284	2.1	118	August 2	187	1.2	16
February 12	278	2.1	118	August 6	146	1.1	13
February 15	277	2.0	112	August 10	137	1.0	12
February 18	270	1.95	103	August 14	126	.9	4
February 24	241	1.8	55	August 18	123	.8	4
February 27	236	1.7	53	August 22	214	1.5	56
March 4	243	1.8	68	August 26	173	1.1	15
March 8	234	1.7	43	August 29	150	.9	13
March 13	210	1.5	20	September 2	118	.8	4
March 16	202	1.45	18	September 6	114	.7	5
March 20	188	1.4	17	September 10	101	.6	0
March 25	161	1.2	12	September 12	304	2.25	128
March 29	144	1.0	8	September 13	587	3.95	661
April 2	138	1.0	7	September 14	389	2.8	270
April 6	134	.9	6	September 18	227	1.4	36
April 10	122	.8	2	September 22	509	3.4	465
April 13	320	2.4	183	September 23	654	4.5	922
April 18	234	1.7	57	September 25	265	1.8	99
April 23	247	1.8	75	September 28	566	3.85	643
April 28	614	4.25	782	October 2	220	1.6	63
May 2	226	1.6	49	October 7	374	2.6	226
May 5	3,819	23.6	17,663	October 9	905	5.75	1,693
May 6	1,338	8.8	3,477	October 12	352	2.6	239
May 9	295	2.8	261	October 16	211	1.6	52
May 11	2,724	13.9	8,602	October 19	176	1.3	24
May 16	280	2.3	167	October 22	299	2.3	183
May 20	215	1.9	88	October 23	455	3.4	394
May 21	1,160	7.6	2,816	October 24	621	4.35	718
May 27	3,819	23.6	17,663	October 26	673	4.55	782
June 2	1,544	7.7	2,993	October 29	433	3.1	348
June 8	382	1.9	93	November 2	349	2.65	218
June 13	330	1.5	29	November 6	282	2.3	135
June 17	298	1.4	26	November 12	401	3.1	333
June 18	840	4.45	1,051	November 16	325	2.6	203
June 19	1,631	8.2	3,177	November 26	250	1.9	103
June 20	934	5.15	1,201	November 28	270	2.0	137
June 27	366	1.9	82	December 2	565	3.9	670
July 2	308	1.5	30	December 6	418	3.0	408
July 4	3,869	18.7	16,080	December 10	360	2.7	287
July 5	2,169	10.55	5,594	December 16	314	2.3	213
July 6	1,784	10.25	4,418	December 20	288	2.2	181
July 7	1,133	6.5	2,389	December 23	282	2.1	160
July 8	3,653	17.6	14,756	December 27	269	2.0	141
July 9	2,107	10.6	5,979	December 29	257	1.95	126

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1908.

[By S. Jaso.]

Date.	Area of section.	Gage height.	Discharge.	Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	*Feet.*	*Sec.-ft.*		*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 3	242	1.9	113	July 9	539	3.85	696
January 8	240	1.9	115	July 13	198	1.45	54
January 12	235	1.8	90	July 14	571	4.05	825
January 17	225	1.7	87	July 17	313	2.15	162
January 21	218	1.65	87	July 23	180	1.0	7
January 25	213	1.6	74	July 29	147	.9	7
January 28	291	2.2	173	July 31	3,193	15.85	12,932
February 3	220	1.7	88	August 5	243	2.1	168
February 7	219	1.6	80	August 8	164	1.4	53
February 11	211	1.6	77	August 12	153	1.2	43
February 16	193	1.4	67	August 15	126	.9	13
February 21	186	1.4	59	August 18	117	.8	5
February 26	178	1.3	55	August 21	631	4.65	1,396
March 2	172	1.2	42	August 24	193	1.65	97
March 10	143	1.0	20	August 28	138	1.1	20
March 13	130	.85	9	September 2	111	.8	4
March 16	128	.8	10	September 7	97	.6	4
March 21	126	.8	9	September 11	122	.9	14
March 24	120	.8	7	September 15	146	1.25	34
April 4	96	.6	3	September 17	453	3.6	485
April 9	95	.6	4	September 19	309	2.65	260
April 12	2,765	14.05	8,086	September 23	491	3.8	685
April 14	2,346	11.35	6,734	September 28	153	1.3	51
April 17	459	3.05	391	October 1	302	2.65	276
April 20	2,390	12.3	6,856	October 3	183	1.55	80
April 22	1,218	7.6	2,930	October 6	142	1.2	32
April 26	335	2.1	167	October 9	125	1.0	24
April 28	289	1.8	111	October 12	169	1.4	57
May 4	229	1.3	53	October 17	116	.9	22
May 7	202	1.1	28	October 22	109	.7	5
May 14	507	3.3	480	October 23	474	3.95	660
May 15	3,413	16.95	14,164	October 25	518	3.9	634
May 16	1,105	7.8	3,310	October 28	210	1.8	97
May 18	388	3.35	530	November 3	141	1.2	25
May 25	104	1.2	24	November 7	128	.9	12
May 28	130	1.4	57	November 11	107	.8	4
May 31	1,857	9.1	5,351	November 12	3,173	15.85	10,280
June 2	395	3.15	428	November 14	510	4.55	896
June 6	145	1.3	46	November 17	277	2.4	217
June 9	110	1.0	19	November 21	114	1.4	45
June 14	90	.7	2	November 25	105	1.2	33
June 19	67	.5	2	December 3	280	2.8	268
June 23	52	.4	0	December 8	110	1.3	43
June 25	1,008	7.15	3,002	December 13	100	1.1	28
June 27	457	3.45	565	December 16	98	1.0	17
July 2	222	1.8	109	December 21	101	1.0	23
July 5	939	6.3	2,317	December 26	96	1.0	18
July 7	352	2.6	276				

Daily gage height, in feet, of Rio San Juan near La Quemada, Tamaulipas, Mexico, for 1900, 1901, and 1902.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.[a]												
1					6.75	4.35	.....	7.75	.....	0.75	0.95	0.9
2					6.05	11.6	.....	7.65	.....	1.75	.85	.95
3					4.5	9.25	.....	8.35	.....	2.65	.8	1.15
4					3.8	5.5	.....	6.45	0.95	2.05	1.05	1.1
5					2.6	6.8	.....	4.6	.85	1.75	.8	1.1
6					2.2	7.75	.....	4.85	3.0	1.55	.8	1.15
7					2.1	6.7	.....	5.1	2.2	1.45	.8	1.05
8					2.25	4.55	.....	6.1	10.45	1.45	.75	1.05
9					2.2	3.6	.....	8.1	5.0	1.85	.8	.95
10					1.9	3.2	.....	9.95	2.55	1.65	.8	1.15
11					1.85	3.0	.....	13.05	2.45	1.55	.75	1.1
12					1.7	2.9	.....	12.6	2.1	1.5	.7	1.15
13					1.45	2.75	.....	11.25	1.85	1.0	.8	1.15
14					1.4	2.35	.....	9.2	1.6	.9	.8	1.1
15					4.5	2.25	.....	7.6	1.15	.75	.7	.95
16					14.85	2.15	.....	5.95	.8	.75	.65	.95
17					14.8	2.0	.....	.....	.45	.75	.7	1.1
18					10.05	2.8	.....	.....	.8	.85	.95	2.55
19					6.65	2.45	.....	.....	.45	.9	1.05	2.6
20					4.5	.....	.....	.....	.55	.9	.95	1.8
21					6.6	.....	.....	.....	.35	1.8	.85	1.65
22					14.0	.....	4.15	.....	.35	1.7	1.25	1.65
23					14.8	.....	3.45	.....	.25	1.75	1.1	1.45
24					9.95	.....	2.9	.....	.0	1.8	.85	1.45
25					6.50	.....	2.65	.....	.1	1.85	.95	1.15
26					5.15	.....	2.45	.....	.0	1.75	1.05	1.1
27					4.4	.....	3.25	.....	.35	3.05	1.0	.85
28				4.85	4.0	.....	2.85	.....	.25	1.9	1.05	.75
29				3.1	3.6	.....	2.6	.....	.2	1.55	.95	1.1
30				3.6	3.25	.....	7.7	.....	.55	1.15	1.1	1.15
31					3.0	.....	10.9	.....	.....	1.05	.....	1.2
1901.[b]												
1	1.25	1.1	0.8	.1	.0	1.35	9.65	.45	.95	11.05	4.05	7.65
2	1.2	1.0	.8	.1	.0	1.1	5.85	.4	.8	9.55	3.95	3.95
3	1.15	1.0	.8	.1	.0	.95	4.9	.25	12.15	7.2	3.8	3.75
4	1.2	1.0	.8	.1	.0	.85	4.0	1.25	8.6	5.8	3.6	3.35
5	1.2	1.0	.8	.0	.0	10.3	1.95	1.1	4.7	4.9	3.5	3.15
6	1.2	1.0	.8	.0	.0	9.25	1.85	1.3	3.6	4.3	3.35	3.00
7	4.25	1.0	.8	.0	.0	8.85	1.7	1.6	2.35	3.9	3.15	2.85
8	1.25	1.1	.8	.0	.0	8.0	1.75	1.35	3.15	3.65	2.9	2.75
9	1.3	1.1	.75	.0	.0	1.3	5.95	1.3	3.15	3.6	2.8	2.55
10	1.25	1.05	.7	.0	3.55	1.35	6.4	1.3	6.05	3.4	2.75	2.15
11	1.25	1.2	.7	.0	3.75	1.15	5.85	1.15	8.4	3.25	3.2	2.75
12	1.3	1.1	.7	.0	2.55	.95	4.15	1.0	5.6	3.2	3.05	2.75
13	1.35	1.1	.6	.0	1.7	.8	3.2	1.0	3.65	12.0	2.9	2.7
14	1.55	1.1	.6	.0	1.45	.75	3.2	.9	3.35	8.75	2.75	2.7
15	1.3	1.0	.6	.0	1.25	.7	3.05	.8	2.05	4.2	2.55	2.5
16	1.35	1.1	.5	.0	1.15	.6	2.6	.8	2.75	3.1	2.55	2.5
17	1.25	1.0	.5	.0	.95	.5	1.5	.8	4.5	2.85	2.7	2.45
18	1.15	1.0	.5	.0	.8	.5	1.5	.8	5.15	2.7	2.55	2.35
19	1.2	1.0	.5	.0	.7	.5	1.35	.7	3.4	2.6	2.5	2.3
20	1.3	1.0	.5	.0	.65	.4	1.55	.7	4.5	2.5	2.55	2.35
21	1.25	1.0	.4	.0	2.6	.4	1.55	.7	3.35	2.5	2.7	2.45
22	1.2	1.0	.4	.0	2.25	.4	1.1	.65	2.55	7.05	2.6	2.5
23	1.2	.95	.4	.0	1.85	.4	.7	.65	2.3	11.4	2.6	2.5
24	1.25	.9	.4	.0	1.4	.4	.6	.6	2.05	10.35	2.6	2.4
25	1.1	.9	.3	.0	1.3	.4	.4	.4	1.95	9.0	2.5	2.4
26	1.2	.9	.2	.0	5.0	.4	.5	.4	16.35	7.0	2.5	2.3
27	1.2	.9	.2	.0	2.0	.35	.35	.4	17.1	5.55	2.45	2.3
28	1.2	.8	.2	.0	3.15	.45	2.6	.4	13.3	5.0	9.35	2.4
29	1.2	.....	.2	.0	2.2	22.0	2.35	1.2	8.1	4.55	11.3	2.35
30	1.3	.....	.15	.0	1.85	19.55	.65	1.7	5.8	4.25	12.1	2.4
31	1.3	.....	.1	.....	1.65	.....	.55	1.15	.....	4.25	.....	2.4

[a] Gage heights at this station affected by Rio Grande. Gage heights for 1900 complete so far as Mexican records exist.

[b] No flow April 28–May 9, 1901.

Daily gage height, in feet, of Rio San Juan near La Quemada, Tamaulipas, Mexico, for 1900, 1901, and 1902—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1902.						1902.					
1	2.4	1.6	1.3	0.55	0.9	16	2.0	1.7	0.8	0.85	.....
2	2.5	1.6	1.3	.5	.85	17	2.1	1.7	.8	11.55	.....
3	2.75	1.6	1.2	.45	.8	18	2.0	1.6	.8	8.8	.....
4	2.6	1.6	1.15	.45	.75	19	1.85	1.6	.75	8.25	.....
5	2.55	1.6	1.1	.5	.85	20	2.2	1.55	.7	4.85	.....
6	2.55	1.6	1.0	.5	1.6	21	1.9	1.5	.7	3.1	.....
7	2.55	1.6	1.0	.4	13.4	22	1.9	1.5	.65	2.15	.....
8	2.6	1.6	.9	.45	8.4	23	1.85	1.55	.65	1.8	.....
9	2.55	1.65	.9	.45	4.55	24	1.85	1.55	.6	1.45	.....
10	2.6	1.6	.9	.45	2.35	25	1.8	1.5	.6	1.35	.....
11	2.6	1.6	.9	.4	1.95	26	1.75	1.5	.6	1.35	.....
12	2.0	1.7	.85	.35	1.65	27	1.8	1.4	.6	1.25	.....
13	2.05	1.7	.85	.3	1.45	28	1.8	1.3	.55	1.2	.....
14	2.0	1.7	.85	1.2	1.35	29	1.8	.....	.55	1.05	.....
15	2.0	1.7	.8	.85	.....	30	1.8	.....	.55	.95	.....
						31	1.7	.....	.5	.....	.....

NOTE.—Gage heights at this station affected by Rio Grande.

Daily gage height, in feet, of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, for 1902 to 1904, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	.....	.....	.....	.....	.....	0.5	−0.45	2.95	−0.3	14.9	2.75	6.3
2	.....	.....	.....	.....	.....	.5	− .5	9.1	− .3	12.35	2.1	7.5
3	.....	.....	.....	.....	.....	.4	− .5	5.55	− .3	8.6	1.9	4.6
4	.....	.....	.....	.....	.....	.3	− .55	3.4	− .3	6.65	2.7	3.3
5	.....	.....	.....	.....	.....	.3	− .6	1.8	− .2	4.4	2.85	2.6
6	.....	.....	.....	.....	.....	.3	− .6	1.25	1.6	2.75	2.2	2.15
7	.....	.....	.....	.....	.....	.3	3.75	.7	3.8	3.45	1.8	1.75
8	.....	.....	.....	.....	.....	.3	3.0	.55	4.45	3.25	1.55	4.9
9	.....	.....	.....	.....	.....	.2	2.9	.5	7.25	2.85	1.45	2.3
10	.....	.....	.....	.....	.....	.2	2.9	.5	3.55	2.5	1.35	1.85
11	.....	.....	.....	.....	.....	.2	2.65	.5	2.45	2.05	1.2	1.75
12	.....	.....	.....	.....	.....	.1	2.0	.5	2.2	1.9	1.1	1.45
13	.....	.....	.....	.....	.....	.1	1.85	.4	5.65	1.8	1.05	1.25
14	.....	.....	.....	.....	.....	.1	1.8	.4	3.75	1.5	1.0	1.1
15	.....	.....	.....	.....	1.15	.1	1.3	.4	3.08	14.15	1.0	1.3
16	.....	.....	.....	.....	1.0	.0	1.3	.3	2.7	13.75	1.0	1.2
17	.....	.....	.....	.....	.95	.0	.8	.3	1.55	9.05	1.0	1.2
18	.....	.....	.....	.....	.9	− .05	.5	.25	1.05	5.5	1.0	1.2
19	.....	.....	.....	.....	.8	− .1	.4	.1	.65	4.3	1.0	1.2
20	.....	.....	.....	.....	.8	− .1	.3	.1	.45	3.8	.9	1.1
21	.....	.....	.....	.....	1.05	− .1	.15	.05	.25	3.3	.85	1.1
22	.....	.....	.....	.....	1.3	− .2	.05	.0	.15	3.05	.8	1.1
23	.....	.....	.....	.....	1.1	− .2	.0	.0	.35	2.75	.8	1.1
24	.....	.....	.....	.....	.95	− .2	.0	.0	2.6	2.5	1.1	1.1
25	.....	.....	.....	.....	.9	− .3	− .1	.0	4.45	2.3	2.1	1.1
26	.....	.....	.....	.....	.8	− .3	− .1	− .1	5.8	2.15	1.5	1.1
27	.....	.....	.....	.....	.75	− .35	− .2	− .2	4.0	1.95	1.4	1.0
28	.....	.....	.....	.....	.7	− .4	− .2	− .2	7.4	1.8	1.4	1.0
29	.....	.....	.....	.....	.6	− .4	−2.65	− .2	8.7	1.7	.95	1.0
30	.....	.....	.....	.....	.55	− .4	11.95	− .25	4.55	8.05	.9	1.0
31	.....	.....	.....	.....	.5	.....	4.25	− .3	.....	4.25	.....	1.0
1903.												
1	1.0	0.7	.....	.....	3.95	.3	2.5	21.5	3.2	1.75	1.0	.9
2	.95	.7	.....	.....	2.6	.2	1.85	14.3	3.3	1.65	.95	.9
3	.9	.7	.....	.....	3.6	.2	1.55	7.25	3.35	1.55	.9	.9
4	.9	.6	.....	.....	2.15	1.55	1.35	4.0	4.9	1.45	.9	.9
5	.9	.6	.....	.....	1.65	1.4	2.8	3.3	3.85	1.35	1.05	.9
6	.9	.6	.....	.....	2.95	2.9	7.0	2.85	3.4	1.25	2.05	.9
7	.9	.6	.....	.....	4.7	4.95	5.6	2.45	3.0	1.15	1.5	.9
8	.9	.6	.....	.....	2.75	3.2	3.95	2.25	2.85	1.1	1.15	1.0
9	.9	.6	.....	.....	2.2	2.25	2.65	2.0	2.85	1.05	1.0	1.0
10	.9	.55	.....	.....	2.0	2.6	2.0	1.65	2.7	1.0	.95	1.0

Daily gage height, in feet, of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, for 1902 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
11	0.9	0.5	.....	.....	3.3	3.5	1.6	1.45	2.45	1.95	0.9	1.0
12	.9	.5	.....	.....	3.45	2.5	1.25	2.0	2.35	1.45	.9	1.0
13	.9	.5	.....	.....	2.65	11.75	1.05	2.65	2.25	1.25	.9	1.0
14	.9	.5	.....	.....	2.05	13.25	.85	1.95	2.1	1.05	.9	1.0
15	1.0	.5	.....	.....	1.85	6.45	.75	2.4	2.8	.95	.9	1.1
16	1.05	.5	.....	.....	2.05	4.6	.65	12.3	2.85	.9	.9	1.1
17	1.0	.5	.....	.....	1.55	3.8	.6	24.3	2.55	.8	.9	1.1
18	1.1	.5	.....	.....	1.35	3.3	.5	15.6	2.65	.8	.9	1.1
19	1.1	.4	.....	.....	2.5	2.85	.5	9.7	2.15	.7	.8	1.1
20	1.05	.4	.....	.....	2.25	2.3	.4	9.8	2.55	.7	.8	1.1
21	1.0	.4	.....	.....	1.5	2.05	.4	9.1	2.2	.7	.8	1.1
22	.95	.4	.....	.....	1.25	1.95	.3	7.4	2.35	.7	.8	1.1
23	.9	.4	.....	.....	.95	1.85	.3	6.2	2.3	.7	.8	1.1
24	.9	.3	.....	.....	.85	1.75	.2	5.35	2.3	.7	.9	1.1
25	.9	.3	.....	.....	.75	1.65	.2	5.1	3.9	2.7	.9	1.1
26	.9	.3	.....	.....	.65	1.55	.1	4.5	3.45	1.85	.9	1.1
27	.9	.3	.....	.....	.55	1.45	.1	3.8	2.6	1.35	.9	1.1
28	.8	.3	.....	.....	.45	5.35	.0	3.65	2.25	1.2	.9	1.1
29	.8	.....	.....	.....	.35	5.15	.0	3.5	2.05	1.1	.9	1.1
30	.8	.....	.....	.....	.3	3.65	2.2	3.4	1.85	1.05	.9	1.0
31	.8	.....	.....	.....	.3	.....	7.5	3.25	.....	1.2	.....	1.0
1904.												
1	1.0	.8	0.5	0.95	1.05	1.65	.65	1.05	.25	6.95	2.2	3.8
2	1.0	.8	.5	.9	6.0	1.45	.55	.85	.05	6.4	2.2	3.8
3	1.0	.8	.5	13.76	4.1	1.25	.45	.75	.0	5.55	2.25	3.7
4	1.0	.8	.4	5.6	3.1	1.05	3.05	.65	.0	5.5	2.3	3.6
5	1.0	.8	.4	5.15	4.6	.85	1.9	.55	.0	5.15	2.45	3.45
6	1.1	.8	.4	3.95	2.0	1.5	3.4	.5	.0	6.7	2.5	3.3
7	1.1	.8	.4	1.95	1.55	11.5	2.2	.4	4.6	5.45	2.65	3.3
8	1.1	.8	.35	1.65	1.6	12.2	1.5	.35	7.6	4.7	2.8	3.3
9	1.1	.8	.3	1.45	8.3	8.2	1.15	6.0	7.7	4.4	2.8	3.25
10	1.1	.7	.3	1.25	8.0	4.8	.9	3.65	8.9	4.1	2.9	3.15
11	1.1	.7	.3	1.05	4.7	2.5	.8	3.55	6.75	3.95	2.9	3.1
12	1.05	.7	.3	.9	2.55	2.1	.7	4.7	2.75	3.85	2.8	3.1
13	1.0	.7	.3	.8	2.0	1.85	.6	5.1	12.2	3.7	2.8	3.0
14	1.0	.7	.2	.75	7.35	1.55	.5	3.25	6.15	3.45	2.8	3.0
15	1.0	.8	.2	.65	11.25	1.95	.4	2.35	15.25	3.25	2.8	2.95
16	1.0	.8	.2	.6	7.85	1.75	.4	2.85	27.0	3.1	2.7	2.9
17	1.0	.8	.2	.5	3.75	1.55	.35	2.65	22.5	3.0	2.7	2.9
18	1.0	.75	.2	.5	2.3	1.35	.3	2.3	13.8	2.9	2.55	2.85
19	1.0	.7	.2	.5	1.65	1.15	.25	1.7	9.6	2.8	3.1	2.8
20	1.0	2.0	.2	.4	1.45	2.0	.2	1.3	6.75	2.7	2.8	2.8
21	.9	2.3	.1	.4	1.3	6.5	.2	.95	6.1	2.6	2.8	2.8
22	.9	1.5	.1	.4	1.15	4.1	.2	.9	16.6	2.55	2.7	2.8
23	.9	1.1	.1	.35	.95	2.55	.1	.8	15.6	2.5	2.7	2.8
24	.9	.95	.1	2.0	.9	3.0	.1	.75	8.45	2.4	2.7	2.8
25	.9	.85	.1	2.75	.9	2.05	6.8	1.15	6.5	2.35	2.7	2.8
26	.85	.7	.1	1.75	.9	1.35	4.8	.95	10.2	2.25	2.7	2.7
27	.8	.6	.1	1.3	.8	.95	3.4	.65	18.45	2.2	2.7	2.6
28	.8	.6	2.7	1.05	.8	.85	2.55	.55	15.6	2.2	2.7	2.5
29	.8	.6	1.9	1.05	1.15	.75	2.15	.45	9.65	2.2	2.7	2.5
30	.8	.....	1.3	1.3	3.3	.65	1.7	.4	8.0	2.2	2.7	2.6
31	.8	.....	1.1	.....	2.15	.....	1.25	.35	.....	2.2	.....	2.6
1907.												
1	2.9	2.3	1.7	1.0	1.85	5.05	1.55	1.2	.8	1.75	2.55	3.5
2	2.9	2.35	1.7	1.0	1.6	6.6	1.45	1.2	.8	1.55	2.6	3.85
3	2.9	2.3	1.7	1.0	1.5	3.6	1.4	1.2	.8	1.4	2.4	3.55
4	2.85	2.3	1.8	1.0	6.1	3.05	18.2	1.1	.8	1.3	2.4	3.35
5	2.8	2.2	1.75	1.0	20.75	2.55	9.7	1.1	.8	1.2	2.35	3.2
6	2.8	2.2	1.7	.9	8.15	2.2	9.0	1.05	.7	1.1	2.3	3.05
7	2.7	2.15	1.7	.9	5.0	2.05	8.0	1.0	.7	2.55	2.3	2.9
8	2.7	2.1	1.7	.9	3.15	1.85	17.4	1.0	.7	2.0	2.25	2.8
9	2.7	2.1	1.6	.8	2.75	1.75	9.25	1.0	.65	3.6	2.2	2.7
10	2.7	2.1	1.6	.8	2.55	1.65	4.8	1.0	.6	3.9	2.2	2.7
11	2.7	2.1	1.6	.8	11.9	1.6	3.85	.95	.6	3.25	2.2	2.6
12	2.6	2.1	1.5	2.65	5.5	1.5	3.7	.9	2.05	2.5	3.3	2.55
13	2.6	2.1	1.5	2.5	4.15	1.5	4.2	.9	3.8	2.15	3.0	2.5
14	2.6	2.0	1.5	2.2	2.95	1.4	3.45	.9	2.65	1.85	3.1	2.4
15	2.6	2.0	1.5	2.05	2.7	1.4	2.75	.85	2.0	1.7	2.7	2.4

Daily gage height, in feet, of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, for 1902 to 1904, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16	2.5	2.0	1.45	1.9	2.25	1.4	2.35	0.8	1.6	1.6	2.6	2.3
17	2.5	2.0	1.4	1.8	2.15	1.4	2.1	.8	1.5	1.5	2.55	2.3
18	2.5	1.95	1.4	1.7	2.05	5.65	1.95	.8	1.45	1.4	2.5	2.3
19	2.5	1.9	1.4	1.7	1.9	7.4	1.75	.9	1.45	1.3	2.5	2.25
20	2.5	1.9	1.35	1.6	6.95	4.8	1.7	1.0	1.4	1.3	2.4	2.2
21	2.4	1.9	1.3	1.5	8.25	3.95	1.6	.9	1.35	1.6	2.3	2.2
22	2.4	1.8	1.3	1.7	4.7	3.15	1.55	1.5	3.15	1.95	2.2	2.2
23	2.35	1.8	1.3	1.8	2.95	2.75	1.5	1.35	4.0	3.2	2.1	2.1
24	2.3	1.8	1.2	1.6	2.5	2.55	1.4	1.2	2.4	4.1	2.0	2.1
25	2.3	1.8	1.2	1.5	2.25	2.3	1.7	1.15	1.7	3.55	2.0	2.1
26	2.3	1.7	1.2	1.4	2.05	2.05	1.65	1.1	1.55	4.45	1.9	2.0
27	2.3	1.7	1.1	3.85	16.6	1.9	1.55	1.0	2.2	3.85	1.95	2.0
28	2.3	1.7	1.1	4.15	20.8	1.85	1.45	9.5	3.6	3.4	2.0	2.0
29	2.3	.....	1.0	2.8	8.6	1.75	1.4	.9	2.6	3.1	2.1	1.95
30	2.3	.....	1.0	2.15	5.2	1.65	1.3	.9	2.0	2.85	2.5	1.9
31	2.3	.....	1.0	.....	3.9	.....	1.3	.85	.....	2.65	.....	1.9
1908.												
1	1.9	1.8	1.2	.6	1.5	4.1	2.0	6.25	.8	2.5	1.3	1.0
2	1.9	1.7	1.2	.6	1.45	2.9	1.9	4.9	.8	2.3	1.3	1.0
3	1.9	1.7	1.2	.6	1.35	2.15	1.9	3.15	.7	1.6	1.15	2.55
4	1.9	1.7	1.1	.6	1.3	1.75	2.15	2.4	.7	1.4	1.0	2.25
5	1.9	1.7	1.1	.6	1.25	1.4	4.85	2.0	.7	1.25	1.0	1.85
6	1.9	1.7	1.1	.6	1.2	1.3	3.9	1.75	.6	1.15	.95	1.55
7	1.9	1.6	1.0	.6	1.1	1.2	2.45	1.5	.6	1.0	.9	1.4
8	1.9	1.6	1.0	.6	1.0	1.1	1.95	1.35	.6	1.0	.9	1.3
9	1.85	1.6	1.0	.6	1.0	1.0	2.7	1.35	.65	.95	.8	1.2
10	1.8	1.6	1.0	.6	.9	.9	2.95	1.55	1.0	.9	.8	1.2
11	1.8	1.6	.9	6.8	.9	.8	1.95	1.4	.9	.9	.8	1.1
12	1.8	1.5	.9	14.05	.8	.8	1.65	1.15	.8	1.35	15.95	1.1
13	1.8	1.5	.85	13.75	1.3	.75	1.45	1.0	.7	1.25	5.85	1.1
14	1.75	1.5	.8	11.05	3.15	.7	2.7	.95	.7	1.0	4.4	1.0
15	1.7	1.5	.8	5.6	17.5	.7	3.75	.9	1.15	1.0	3.5	1.0
16	1.7	1.4	.8	3.8	10.3	.65	2.55	.85	.9	.95	3.0	1.0
17	1.7	1.4	.8	3.0	4.8	.6	2.1	.8	2.3	.9	2.45	1.0
18	1.7	1.4	.8	2.4	3.35	.6	1.8	.8	3.4	.9	2.15	1.0
19	1.7	1.4	.8	2.0	2.65	.5	1.65	.7	3.05	.9	1.75	1.0
20	1.65	1.4	.7	11.0	2.15	.5	1.5	.7	2.25	.8	1.55	1.1
21	1.6	1.4	.8	10.05	1.85	.5	1.35	4.2	2.35	.7	1.45	1.0
22	1.6	1.4	.8	7.25	1.65	.5	1.15	1.8	2.85	.7	1.3	1.0
23	1.6	1.3	.8	3.85	1.3	.4	.9	1.35	3.7	4.05	1.2	1.0
24	1.6	1.3	.8	2.7	1.2	1.75	1.45	1.7	2.5	5.0	1.2	1.0
25	1.6	1.3	.8	2.3	1.35	10.45	1.3	1.7	1.9	3.9	1.2	1.0
26	1.55	1.3	.8	2.1	1.8	6.6	1.15	1.45	1.6	2.9	1.2	1.0
27	1.5	1.3	.8	1.8	1.6	3.35	1.0	1.25	1.45	2.2	1.1	1.0
28	2.2	1.3	.8	1.75	1.35	5.4	.95	1.05	1.3	1.75	1.0	1.0
29	2.05	1.3	.7	1.7	1.25	3.75	.9	1.0	1.15	1.6	1.0	1.0
30	1.9	.....	.7	1.55	1.15	2.7	.9	.9	1.15	1.5	1.0	1.0
31	1.8	.....	.6	.....	8.35	.....	13.1	.85	.....	1.3	.....	1.0

MISCELLANEOUS MEASUREMENTS IN RIO GRANDE DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in the Rio Grande drainage basin in 1907 and 1908:

Miscellaneous discharge measurements in Rio Grande basin in 1907 and 1908.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Nov. 10, 1907	Willow Creek	Rio Grande	Creede, Colo		a 20
Mar. 17, 1908	Dry Gulch	do	Wason, Colo		a 2
June 11, 1907	Fox Creek	Conejos	Mogote, Colo		a 30
June 27, 1907	do	do	do		a 2
July 30, 1907	do	do	do		0
Nov. 8, 1907	do	do	do		0
May 18, 1908	do	do	do		a 2
June 9, 1908	do	do	do		0
July 31, 1907	San Antonio	do	Antonito, Colo		a 50
May 18, 1908	do	do	do	b 11.37	723
June 9, 1908	do	do	do	b 12.55	282
May 5, 1908	Lucero Creek	Rio Taos	In canyon 10 miles above Taos, N. Mex.		43.7
Do	do	do	Above ditch near Taos, N. Mex.		33.2
Do	do	do	Above Pueblo pasture near Taos.		7.1
Nov. 13, 1907	Mimbres River	Rio Grande	At dam site near Faywood Hot Springs, N. Mex.		19.4
May 17, 1907	Bonita Creek	Hondo River	Fort Stanton, N. Mex		10.6
May 18, 1907	do	do	Below diversions at Peter's farm, above Fort Stanton, N. Mex.		8.2
Do	Bonita Creek, West Fork.	do	Just above forks, near Parsons, N. Mex.		4.5
Do	Bonita Creek, South Fork.	do	Just above forks, near Parsons, N. Mex.		8.0
Oct. 25, 1907	Fresnal River	Penasco River	High Rolls, N. Mex		10.3
Oct. 24, 1907	Alamo River	do	At Wood's ranch, 10 miles southeast of Alamo Gordo, N. Mex.		3
Feb. 1, 1907	Black River	Pecos River	Kennon's ranch, sec. 8, T. 27 N., R. 26 E, New Mexico.		0.25
Sept. 22, 1907	do	do	Above Judkins's ranch, sec. 3, T. 27 N., R. 26 E.		1.1
Do	do	do	Below Judkins's ranch, sec. 24, T. 28 N., R. 26 E.		9.6
Mar. 26, 1907	Black River canal	Black River	U. S. R. S. canal at spillway, 600′ below headgate and between R. 27 and R. 28 E, New Mexico.	.34	2.1
Do	do	do		.41	2.4
Do	do	do		1.02	11.1
Do	do	do		.84	7.8
Do	do	do		.58	4.2
Feb. 1, 1907	Blue Spring Creek	do	Judkins's ranch, sec. 27, T. 28 N., R. 26 E.		15
Sept. 22, 1907	do	do	Above Judkins's dam, sec. 28, T. 28 N., R. 26 E.		15.2
Do	do	do	Below Judkins's dam, sec. 27, T. 28 N., R. 26 E.		0.25
Feb. 1, 1907	Blue Spring canal, North Branch.	Blue Spring Creek	do		0.9
Do	Blue Spring canal, South Branch.	do	do		1.8

a Estimated.

b Water surface measured down from cross painted at foot of truss post, downstream side of bridge, 33 feet from right abutment of bridge. Highway bridge 1 mile south of Antonito.

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DEPARTMENT OF THE INTERIOR
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WATER-SUPPLY PAPER 249

SURFACE WATER SUPPLY OF THE UNITED STATES

1907–8

PART IX. COLORADO RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

W. B. FREEMAN AND R. H. BOLSTER

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SURFACE WATER SUPPLY OF THE COLORADO RIVER BASIN, 1907–8.

By W. B. Freeman and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country. These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a pubilc utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects.

If, by the drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
			VIII	248	Western Gulf of Mexico.
III	243	Ohio River basin.	IX	249	Colorado River basin.
IV	244	St. Lawrence River basin.	X	250	Great Basin.
V	245	Upper Mississippi River and Hudson Bay basins.	XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.= Annual Report; B.= Bulletin; W. S.= Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	....do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	....do	1903.
W. S. 124 to 135	....do	1904.
W. S. 165 to 178	....do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907–8.
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65,75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47,(48)	65,75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65,75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35),36	48	65,75	(82),83	(97),98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65,75	83	98	127	168	204	242
St. Lawrence River	36	49	65,75	(82),83	97	129	170	206	244
Hudson Bay			66,75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48,(49)	65,75	83	98	128	169	205	243
Upper Mississippi River	36	49	65,75	83	98,(99)	128, (130)	171	207	245
Missouri River	(36),37	49,(50)	66,75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66,75	(83),84	(98),99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66,75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37), 38	50	66,75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66,75	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66,75	85	100	134	177	213	251
North Pacific coast	38	51	66,75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the

basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.

1 horsepower equals 1 second-foot falling 8.80 feet.

1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 13, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = \sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of

sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200[a]) and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The editions of both of these water-supply papers are practically exhausted. They can, however, be consulted at most of the larger libraries of the country or they can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents for No. 180 and 35 cents for No. 200. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

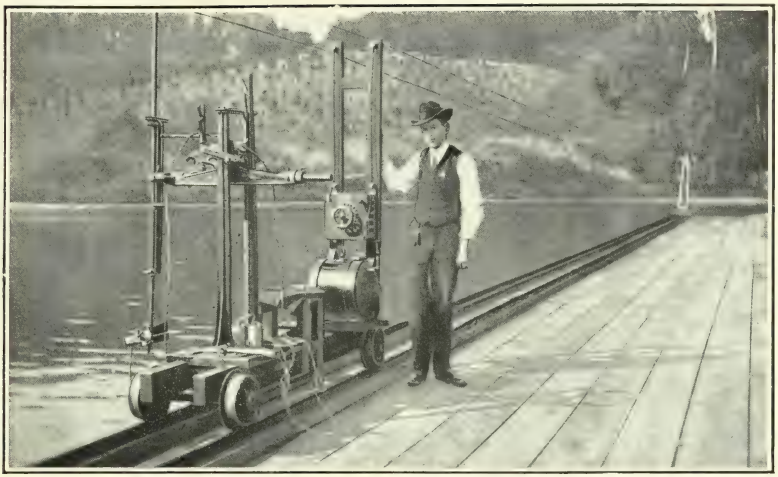
Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible, stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced ebually for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth of the section at the time of measurement.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0 8 depth method.

discharge of the stream. (For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method with its various modifications of surface, subsurface, and tube or rod floats is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared

which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, *B*.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average

coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and

from these applications the tables of monthly discharge and run-off are computed.

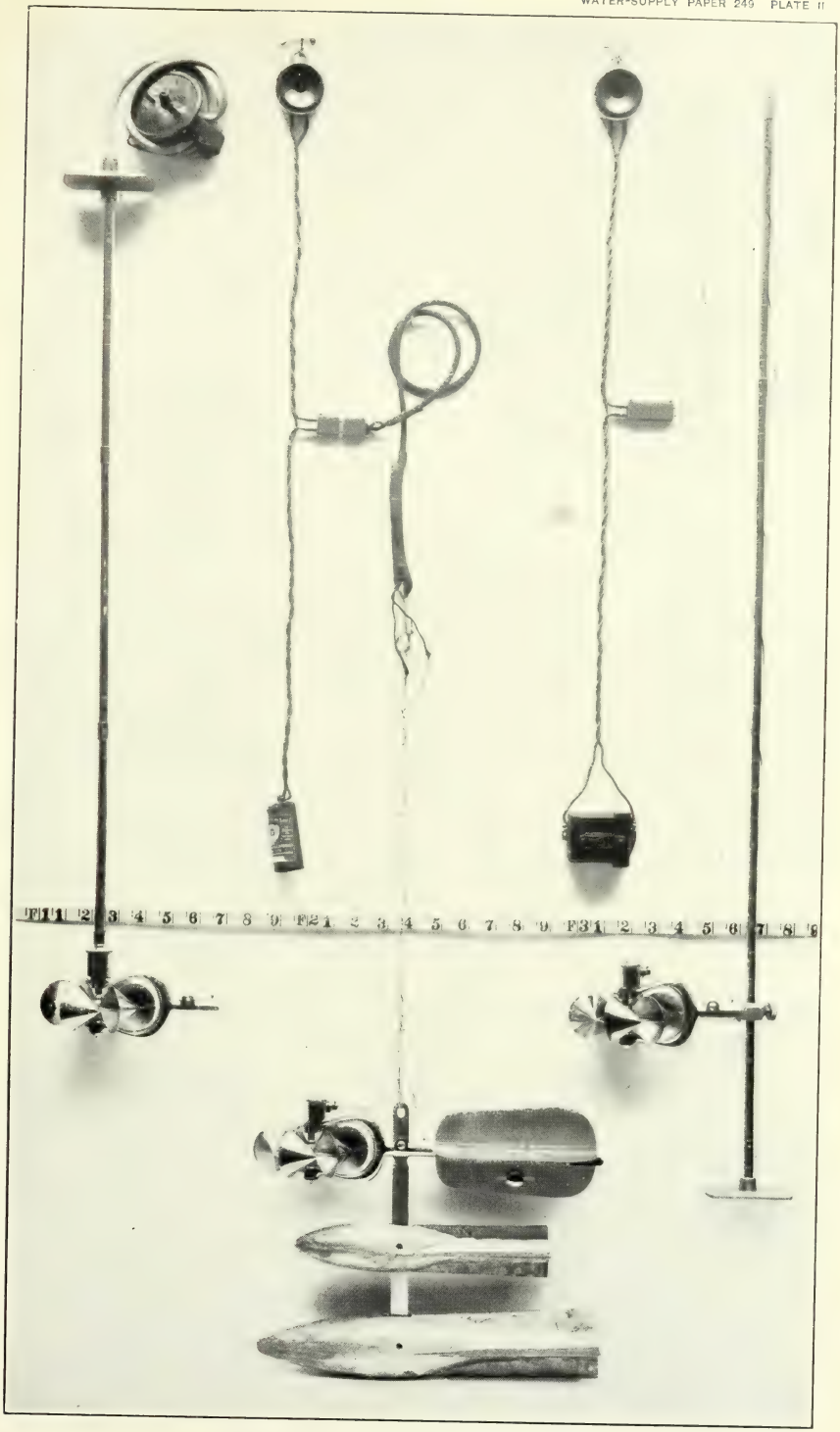
Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve, and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are as a rule comparatively permanent during low and medium stages, and when the flow is sufficiently well defined by an adequate number of discharge



PRICE PENTA-RECORDING CURRENT METERS.

measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. For illustrative examples of stations of this type see Water-Supply Paper 246.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semi-permanent and shifting channels. It is not absolutely correct but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either

reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow.

The following method of determining the daily discharge of streams of this class is now used by the engineers of the United States Geological Survey almost exclusively, owing to the rapidity with which the necessary computations can be made, the clearness with which all changes in conditions of flow, so far as known, can be followed, and the accuracy of the results obtained.

In the graphic method of determining the daily discharge of streams with changeable beds, which was devised by R. H. Bolster, the discharge measurements for the entire year are first plotted with discharges as abscissas and gage heights as ordinates. The points so plotted are considered chronologically and, even though scattered, will usually locate one or more fairly well defined curves, called standard curves. (See Pl. III.) In general the number and position of these standard curves are determined by the radical changes in the stream bed due to floods.

When stream beds change very rapidly it is necessary to change the position of the rating curve each day, making a new curve daily. This daily curve is of the same form as the standard curve and is parallel to it with respect to ordinates. For a day when a measurement is made the rating curve passes through such plotted measurement, the discharge for the day being read off from the scale of discharge in second-feet, at the point of intersection of the curve and the mean gage height for the day. In order to locate the rating curve for other days lines are drawn connecting consecutive measurements. These lines are called correction curves and should have the same curvature as that portion of the standard curve which lies vertically above or below them. These lines are divided into as many equal parts as there are days intervening between the measurements, on the assumption that the change in conditions of flow between any two consecutive measurements is uniform from day to day. The daily rating curve will then pass through these points of division, and the discharge is read directly from these curves at their point of intersection with the observed daily gage heights.

In order to facilitate the use of the method and obviate the use of daily rating curves, and make it as rapid in application as the common method for permanent stations, the standard curve or curves, together with a vertical line of reference, should be transferred from the original station sheet to tracing cloth, which can be readily shifted vertically to any desired position by always keeping the two vertical reference lines coincident with each other. Thus the daily rating curve, which is merely the standard curve transferred, can be placed in any desired position.

Another way of simplifying the work of applying this method is to use dividers. Always keep one point of the dividers coincident with the standard curve, and always keep both points on the same vertical line of discharge. By spreading the points, the point which is not coincident with the standard curve can be made to trace any daily rating curve desired.

In applying and modifying this method, judgment must be used for long-time intervals of no measurements or for radical changes in the stream bed caused by sudden floods. For another illustrative example of a station of this type see Water-Supply Paper 247.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly-discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

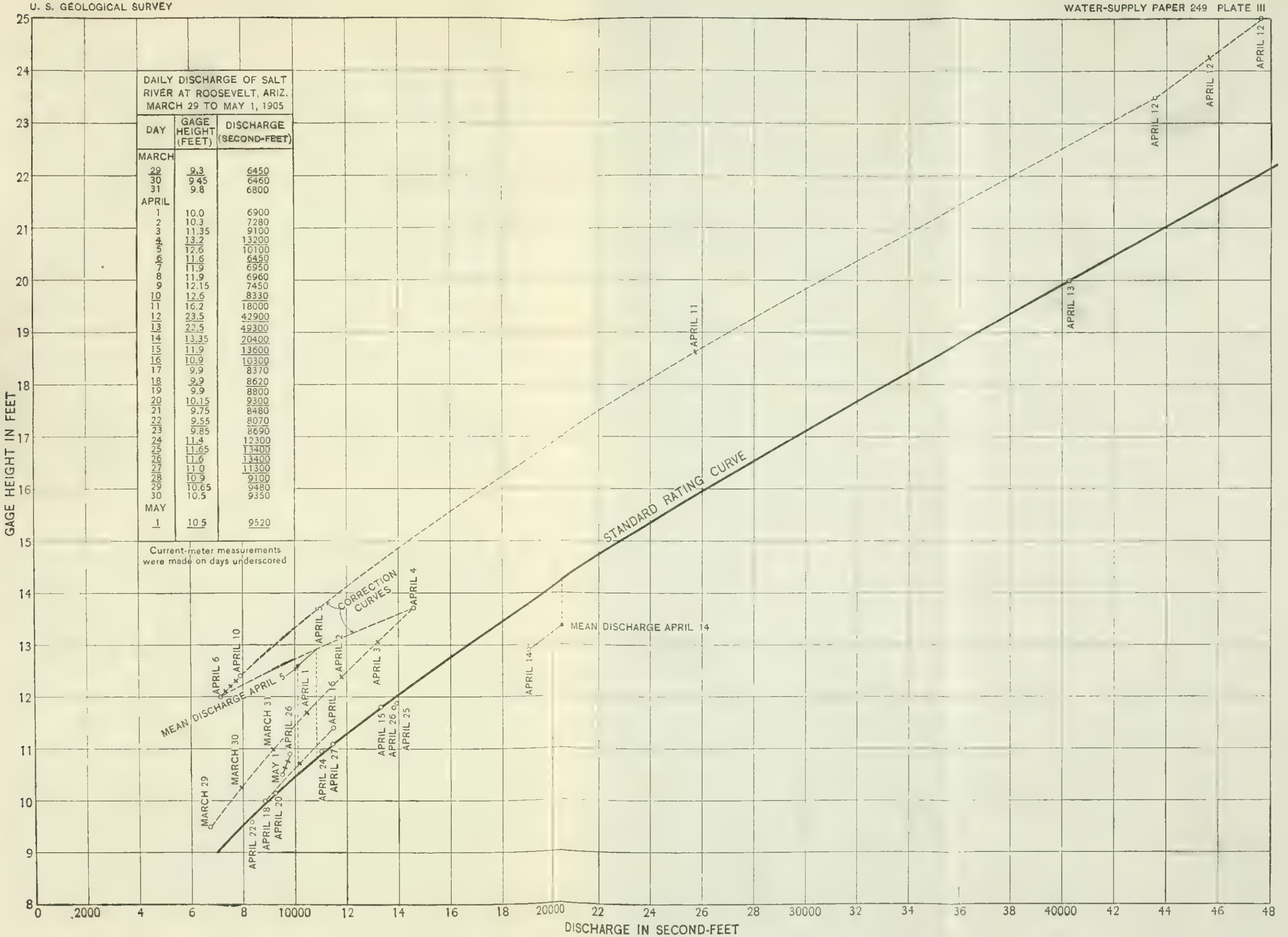
Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work

DAILY DISCHARGE OF SALT RIVER AT ROOSEVELT, ARIZ. MARCH 29 TO MAY 1, 1905

DAY	GAGE HEIGHT (FEET)	DISCHARGE (SECOND-FEET)
MARCH		
29	9.3	6450
30	9.45	6460
31	9.8	6800
APRIL		
1	10.0	6900
2	10.3	7280
3	11.35	9100
4	13.2	13200
5	12.6	10100
6	11.6	6450
7	11.9	6950
8	11.9	6960
9	12.15	7450
10	12.6	8330
11	16.2	18000
12	23.5	42900
13	22.5	49300
14	13.35	20400
15	11.9	13600
16	10.9	10300
17	9.9	8370
18	9.9	8620
19	9.9	8800
20	10.15	9300
21	9.75	8480
22	9.55	8070
23	9.85	8690
24	11.4	12300
25	11.65	13400
26	11.6	13400
27	11.0	11300
28	10.9	9100
29	10.65	9480
30	10.5	9350
MAY		
1	10.5	9520

Current-meter measurements were made on days underscored



GRAPHIC METHOD OF DETERMINING DAILY DISCHARGE.

honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly-discharge table. In the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly-discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it

is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

Special acknowledgments are due for assistance rendered or records furnished by the following parties: Vernon L. Sullivan, territorial engineer of New Mexico; Thos. W. Jaycox, state engineer of Colorado; Caleb Tanner, state engineer of Utah; the United States Indian Service; the United States Reclamation Service; the United States Forest Service; the Central Colorado Power Company; R. I. Meeker; Field, Fellows & Hinderlider; Chris J. Walbran; Wheeler & Whinnerah; Prof. Geo. J. Lyon; the Denver and Rio Grande Railroad Company; the Moffatt road; the Denver Union Water Company; and various engineers and irrigation and power companies, who have furnished the U. S. Geological Survey with valuable data.

All the stations maintained in the San Juan and Gila River drainage basins in New Mexico were in cooperation with the territorial engineer, and more than half of the expense was paid from territorial funds. Special mention should be made of the interest Mr. Sullivan, the territorial engineer, has shown in this work, and of his persistence in carrying it on, though greatly handicapped by lack of funds.

Mr. Tanner, state engineer of Utah, paid the salaries of the observers at about five stations in the Duchesne River drainage, in cooperation with the United States Indian Service and the United States Geological Survey.

Thanks are due Mr. Jaycox, state engineer of Colorado, for suggestions in carrying on the work, and for paying the salaries of some of the observers in Colorado during the first part of 1907.

The Uinta Irrigation Survey, of the United States Indian Service, has borne practically all the expense of discharge measurements at the stations in the Uinta Reservation and vicinity in Utah.

The United States Reclamation Service has furnished all the field data for the stations in the Gunnison drainage basin in Colorado, and the 1907 data for the Gila River drainage basin in New Mexico. It has also paid the expense of maintaining the station on the Grand at Palisades, Colo., for 1908.

All stations in Arizona have been maintained and all computed data furnished by the United States Reclamation Service.

The Salton Sea gage heights were furnished by the Southern Pacific Company, and measurements of flow into Salton Sea by H. R. Edwards, engineer for the New Liverpool Salt Company.

The Central Colorado Power Company has cooperated in the maintenance of practically all the stations in the Grand River drainage basin in Colorado, and has expended several thousand dollars for this work. Until July 1, 1908, the company paid the salaries of gage observers, and since that time it has borne practically all the expense of taking discharge measurements. Special thanks are due Mr. L. E. Ashbaugh and G. H. Matthes of this company for valuable suggestions and data which they have furnished.

Mr. R. I. Meeker was in charge of the work of this district from January 1 to May 1, 1907. He has since taken a very active interest in it, for which special acknowledgments are due him.

Field, Fellows & Hinderlider have furnished data on the flow of the upper Williams Fork in Colorado. Mr. Fellows, of this firm, through his intimate knowledge of the water resources of this section, has been able to give valuable information, and his assistance has been very much appreciated. The Denver and Rio Grande Railroad and the Moffatt road furnished transportation for the Survey hydrographers during the year 1907.

Many of the photographs contained in this paper were obtained from the United States Reclamation Service.

DIVISION OF WORK.

The field data in the Grand River drainage basin were collected under the direction of W. B. Freeman, district engineer, assisted by R. I. Meeker, Jas. B. Stewart, C. L. Chatfield, the engineers of the Central Colorado Power Company, and the United States Reclamation Service. The field data for the Gunnison River drainage were collected by the engineers of the United States Reclamation Service.

The field data in the Duchesne River drainage basin were collected under the direction of W. B. Freeman, district engineer, assisted by I. I. Price and R. H. Fletcher, under the more immediate supervision of H. C. Means, superintendent of irrigation, United States Indian Service.

The field data of the San Juan and Gila River drainage basins, in New Mexico, except those for Gila River near Cliff and San Francisco River at Alma, were taken under the general direction of W. B. Freeman, district engineer, but under the more immediate supervision of Vernon L. Sullivan, territorial engineer, assisted by Jas. B. Stewart, Robt. L. Cooper, and C. D. Miller.

All other field data in the lower Colorado River drainage were collected and the computations therefor were made by the United States Reclamation Service, except as indicated above.

The ratings, special estimates, and studies of the completed data were made by W. B. Freeman, R. H. Bolster, and F. F. Henshaw. The computations and preparation of the completed data for publication were made under the direction of R. H. Bolster, assistant engineer, by F. F. Henshaw, G. C. Stevens, H. D. Padgett, R. C. Rice, J. G. Mathers, and M. I. Walters. The entire report was edited by Mrs. B. D. Wood.

COLORADO RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Colorado River is formed in the southeastern part of Utah by the junction of Grand and Green rivers. The Green is larger than the Grand and is the upward continuation of the Colorado. Including the Green, the entire length of the Colorado is about 2,000 miles. The region drained is about 800 miles long, varies in width from 300 to 500 miles, and contains about 300,000 square miles. It comprises the southwestern part of Wyoming, the western part of Colorado, the eastern half of Utah, practically all of Arizona, and small portions of California, Nevada, New Mexico, and old Mexico. Most of this area is arid, the mean annual rainfall being about 8½ inches. The streams receive their supply from the melting snows on the high mountains of Wyoming, Utah, and Colorado.

The basin comprises two distinct portions. The lower third is but little above the level of the sea, though here and there ranges of mountains rise to elevations of 2,000 to 6,000 feet. This part of the valley is bounded on the north by a line of cliffs which present a bold and in many places vertical step of hundreds or thousands of feet to the tableland above. The upper two-thirds of the basin stands from 4,000 to 8,000 feet above sea level, and is bordered on the east, west, and north by ranges of snow-clad mountains, which attain altitudes varying from 8,000 to 14,000 feet above sea level. Through this plateau the Colorado and its tributaries have cut narrow gorges or canyons in which they flow at almost inaccessible depths. At points where lateral streams enter the canyons are broken by narrow transverse valleys, diversified by bordering willows, clumps of box elder, and small groves of cottonwood. The whole upper basin of the Colorado is traversed by a labyrinth of these canyons, most of which are dry during the greater portion of the year, and carry water only during the melting of the snow and the brief period of the autumnal and spring rains.

Green River and its tributaries[a] drain an area rudely triangular in outline, bounded on the north and east by the Wind River Mountains and the ranges forming the Continental Divide, on the south and east by the White River Plateau and the Roan or Book Cliffs, and on the north and west by the Gros Ventre and Wyoming mountains and the great Wasatch Range. The greatest length of the basin, north and south, is about 370 miles. In an east-west direction it measures at its widest point about 240 miles. The total drainage area is approximately 41,000 square miles, and altitudes range from 14,000 feet in the high mountains to about 3,800 feet at the mouth of the Grand.

The area includes a large part of western Wyoming, northwestern Colorado, and eastern Utah. The Uinta and Uncompahgre Indian reservations are located in this basin in northeastern Utah.

The river heads on the western slope of the Wind River Mountains in western Wyoming, its ultimate source being a number of small lakes fed by the glaciers and immense snow deposits always to be found on Fremont and neighboring peaks. For perhaps 25 miles the river flows northwestward through the mountains. It then turns abruptly and runs in a general southerly direction across western Wyoming into Utah. A few miles below the Wyoming-Utah boundary another sharp turn carries the river eastward near the east end of the range. It then flows southward in Colorado for about 25 miles, turns back into Utah, and continues to flow in a southwesterly and southerly direction until it unites with the Grand to form the Colorado. Its length, measured roughly along the course, is approximately 425 miles.

The topography of the headwater region is rugged in the extreme. The Wind River Range on the east, and the Gros Ventre and Wyoming ranges on the southwest and west gradually close in as they extend outward, forming a basin approximately 7,450 square miles in extent above the discontinued gaging station at Green River, Wyo.

The upper part of this basin is very narrow, but southward the valley opens out; near Fontanelle, Wyo., it is several miles wide; with benches and rolling table-lands extending westward to the foothills of the Wyoming Range and eastward to the bluffs which hug the east bank of the river. At Green River the valley is again narrow—only a few hundred yards in width—and for some distance southward the river runs between bluffs standing so close together that no flood plain is seen. Throughout much of its course in Utah the Green flows through a succession of long, deep, narrow canyons with walls ranging in height from a few hundred to as many thousand feet, separated by short valleys, containing small tracts of arable lands.

[a] The geology of this basin is described in the Eleventh Ann. Rept. U. S. Geol. and Geog. Survey Terr., for 1877, pp. 509–646. Information in regard to the hydrography is contained in the first to fourth annual reports of the Reclamation Service and in United States Geological Survey reports.

In its upper course the Green receives as tributaries numerous streams heading in the Wind River, Gros Ventre, and Wyoming ranges of mountains, some of them extending so far back into the abrupt, ragged canyons that they dovetail with streams flowing in the opposite direction.

The most important of these tributaries are New Fork River, Big Sandy Creek, Labarge Creek, Fontanelle Creek, Black Fork, and Henry Fork. South of the Uinta Mountains the first large stream flowing into the Green is the Yampa, which comes in from the east at the point where the Green turns westward to reenter Utah after its southward journey in Colorado.

Farther south Ashley Creek and Duchesne and White rivers discharge their waters into the Green, Ashley Creek and the Duchesne from the west and the White from the east.

Below this point the only tributaries of importance are Price, Minnie Maude, and San Rafael rivers, which enter from the west, the latter at a point about 32 miles above the junction of the Green and the Grande.

Except for the timber in the high mountains at the headwaters of Green River in Wyoming, the upper portion of the stream is not very extensively forested. The timbered land includes probably 1,500 square miles, with an average stand of about 4,000 feet board measure per acre in that section. Numerous tracts of irrigated and cultivated land extend from the Wyoming line up the river to elevations of 7,000 feet.[a]

In the Green River basin in Utah above the mouth of the Duchesne, there are about 600 square miles of timbered land, with an average stand of nearly 3,000 feet board measure per acre, while there are nearly 2,000 square miles of timbered area and woodland in the drainage basins of the White and Yampa rivers in Colorado.

In the 41,000 square miles which comprise the total drainage area of the Green River, there are considerably over 5,000 square miles of timbered land in addition to a considerable woodland area. The principal species of mountain timber are the Engelmann spruce and lodgepole pine.

Over the plains portion of the basin, which includes considerably over half of it, the average annual precipitation seems to be less than 10 inches annually; over much of the remainder the rainfall averages between 10 and 15 inches, and in only a very small area in the high mountains does the precipitation exceed 20 inches annually.

Throughout this whole basin winters are severe, and most of the streams have a heavy ice cover for several months. There is usually an abundance of snow in the high mountains, but the winters on the plains are frequently quite open. (See Pl. IV, *A* and *B*.)

[a] See also description of New Fork drainage basin in Water-Supply Paper 175, pp. 21 and 22.

A. SNOW AND ICE CONDITIONS ON COLORADO MOUNTAIN STREAMS.

B. THE CONTINENTAL DIVIDE NEAR TOLLAND, COLO.; ELEVATION, 11,666 FEET ABOVE SEA LEVEL.

The oldest and most extensive irrigation development in this basin is on the upper Green River in Wyoming. Recently large irrigation systems have been constructed in the Duchesne River basin. Considerable irrigation is practiced around Vernal, Utah, and also in the vicinity of Greenriver, Utah, along the line of the Denver and Rio Grande Railroad. Along White and Yampa rivers in Colorado, meadow irrigation is extensively practiced and projects are now on foot for the irrigation of 200,000 or 300,000 acres of land in that section.

Excellent reservoir sites are found on the headwaters of the Green River and its upper tributaries, and also along Yampa and White rivers, on Ashley Creek, and other tributaries in the northwestern corner of Utah, and at the headwaters of Duchesne River. A very considerable portion of the flow could be equalized by storage.

Not a water-power plant of any importance whatever exists in the whole drainage area of Green River, though splendid opportunities are presented at the headwaters of many of the tributary streams above all irrigation diversions. Theoretically, at the present time it would be possible, by utilizing known storage facilities, to develop about 1,500,000 horsepower in the basin of the Green, but it is unlikely that the development of this power will be a commercial possibility for a number of years. From Wells, Wyo., to the Wyoming state line, a distance of 225 miles, the stream has an average fall of 11 feet per mile; and from the Wyoming state line to the mouth of Minnie Maud Creek, a distance of 200 miles, the average fall is 7 feet per mile. The waters of this stream and its tributaries are practically unused except for irrigation.

From the junction of Grand and Green rivers the Colorado flows southwestward, passes across the northwestern corner of Arizona, then turns to the south and for the remainder of its course forms a part of the southeastern boundary of Nevada and California and the western boundary of Arizona. It empties into the Gulf of California about 60 miles below Yuma, Ariz. The canyons through which it flows are world-famed and need not here be described.

The Colorado has been called the Nile of America, and like the Nile it is subject to an annual summer rise which comes at the time when the water is most needed for irrigation. It is of interest to compare the Colorado with Nile and Susquehanna rivers. The Nile is similar in type, while the Susquehanna shows the difference in flow between arid and humid regions. In the comparison a normal year, based on a ten-year record for Colorado and Susquehanna rivers and such data as could be found in regard to the Nile, have been used. The Colorado has been taken as the standard of comparison.

The Nile has 5.7 times the drainage area and the Susquehanna about one-eighth the area of the Colorado.

The rainfall in the Nile basin is 3.8 times greater; that in the Susquehanna basin is 4.5 times greater. The run-off per square mile from the Nile basin is 1.9 times greater; that from the Susquehanna basin is 37 times greater. The ratio of run-off to rainfall in the Nile basin is 2 times smaller; that of the Susquehanna basin is 8.2 times greater.

The discharge of the Nile is 10.8 times greater; that of the Susquehanna is 4.5 times greater.

The maximum flow of the Colorado is from 70,000 to 110,000 second-feet and occurs in May, June, or July; for the Nile it is about 353,000 second-feet and occurs about the first of September; for the Susquehanna it is from 200,000 to 400,000 second-feet and occurs during March, April, and May.

The minimum flow of the Colorado is from 2,500 to 3,000 second-feet and occurs during January and February; that of the Nile is about 14,500 second-feet and occurs about the end of May; for the Susquehanna it is from 2,500 to 5,000 second-feet and occurs in September and October.

The mean flow of the Colorado is about 10,700 second-feet; for the Nile it is about 115,800 second-feet; for the Susquehanna it is about 43,000 second-feet.

The water of the Colorado carries an immense amount of sediment, reaching as high as 2,000 parts of sediment to 100,000 parts of water. Prof. R. H. Forbes, in Bulletin 44 of the University of Arizona Agricultural Experiment Station, says:

> On the basis of the profile, constructed from available data for the volume of flow of the Colorado and of the year's silt determinations made in the laboratory, it is estimated conservatively that the river during 1900 brought down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles 1 foot deep, or to make about 164 square miles of recently settled, submerged mud 1 foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

A comparatively small amount of land is irrigated by the waters of the Colorado, because the stream and its tributaries are situated so far below the level of the irrigable lands as to render their diversion extremely difficult or impracticable. Two pumping plants are in operation to lift water for irrigation at Yuma, and several at other points on the river above Yuma. The Imperial canal diverts water from the river at a point about 10 miles, by river, below Yuma.

The principal tributaries of the Colorado below the Grand and Green are San Juan, Little Colorado, Williams Fork, and Gila rivers, which enter from the east, and Virgin River, which enters from the west. With the exception of Virgin River and Williams Fork, these streams and their various tributaries are described in other parts of this report.

The following gaging stations have been maintained on the main Colorado River and in the Green River basin:

Green River at Green River, Wyo., 1895–1906.
Green River at Jensen, Utah, 1903–1906.
Green River at Ouray, Utah, 1904–5.
Green River at Greenriver, Utah, 1894–1896 and 1905–1908.
Colorado River at Hardyville, Ariz., 1905–1907.
Colorado River at Mohave City, Ariz., 1902–3.
Colorado River at Yuma, Ariz., 1895–1908.
Canal stations:
Imperial canal (main) near Calexico, Cal., 1904–5.
Boundary canal near Calexico, Cal., 1905.
Wisteria canal near Calexico, Cal., 1905.
Imperial canal 10 miles below Yuma, Ariz., Mexican boundary line, 1903–1905.
Holt canal at Calexico, Cal., 1904–5.
Hemlock canal at Calexico, Cal., 1904–5.
Alamo channel near Calexico, Cal.
Alamitos canal near Calexico, Cal., 1904–5.
Newfork River at Cora, Wyo., 1905.
Pine Creek at Pinedale, Wyo., 1904–1906.
Pole Creek at Fayette, Wyo., 1904–1906.
Fall Creek at Fayette, Wyo., 1904–5.
Boulder Creek at Boulder (Newfork), Wyo., 1904–1906.
Eastfork River at Newfork, Wyo., 1905–6.
Black Fork of Green River at Granger, Wyo., 1896–1900.
Yampa River at Steamboat Springs, Colo., 1904–1906.
Yampa River at Craig, Colo., 1901–2, 1904–1906.
Yampa River at Maybell, Colo., 1904–5.
Elk River at Trull, Colo., 1904–1906.
Elk Head Creek at Craig, Colo., 1906.
Fortification Creek at Craig, Colo., 1905–6.
Williams River at Hamilton, Colo., 1904–1906.
Milk Creek at Axial, Colo., 1904–5.
Little Snake River at Maybell, Colo., 1904.
Ashley Creek at Vernal, Utah, 1900–1904.
Ashley Creek (Dry Fork) at Vernal, Utah, 1904.
North Fork of White River at Buford, Colo., 1903–1906.
White River at Meeker, Colo., 1901–1906.
White River at White River City, Colo., 1895.
White River at Rangely, Colo., 1904–5.
White River at Dragon, Utah, 1906.
White River at Ouray, Utah, 1904.
South Fork of White near Buford, Colo., 1903–1906.
Marvine Creek near Buford, Colo., 1903–1906.
Duchesne River, North Fork, above Forks, Utah, 1904.
Duchesne River near Myton, Utah, 1899–1908.
Duchesne River, West Fork, above Forks, Utah, 1904.
Rock Creek (East Creek) 10 miles above mouth, Utah, 1904.
Strawberry River in Strawberry Valley, Utah, 1903–1906 and 1908.
Strawberry River at Theodore, Utah, 1908.
Indian Creek in Strawberry Valley, Utah, 1905–6.

Currant Creek 3 miles above mouth of Deep Creek, Utah, 1904.
Red Creek above narrows, Utah, 1904.
Lake Fork (West Fork) 10 miles above Forks, Utah, 1904.
Lake Fork below Forks, Utah, 1904, 1907–8.
Lake Fork near Myton, Utah, 1900–1904, 1907–8.
Lake Fork (East Fork) 8 miles above Forks, Utah, 1904.
Uinta River at Whiterocks, Utah, 1899–1904, 1907–8.
Uinta River at Fort Duchesne, Utah, 1899–1904, 1906–1908.
Uinta River at Ouray School, Utah, 1899–1904.
Whiterocks River at Whiterocks, Utah, 1899–1904, 1907–8.
Price River at Helper, Utah, 1904–1908.

COLORADO PROPER AND GREEN RIVER.

GREEN RIVER AT GREENRIVER, UTAH.

This station (originally called Blake) was established October 21, 1894, discontinued in November, 1896, and reestablished in February, 1905. It is located at the Rio Grande Western Railway bridge at Greenriver railroad station and near the Elgin post-office, in latitude 39° north, longitude 110° 9′ west, in the San Rafael quadrangle of the United States Geological Survey.

The station was established to determine the unappropriated run-off of the river, and the record is very valuable to owners of ranches along the river course. Several irrigation projects are completed and being promoted in this drainage basin.

The last diversion above the station is about 10 miles upstream; there are no diversions below the station. Price River enters from the west about 16 miles above the station.

A new bridge was erected at this point between the periods of maintenance of the original station and the present one. The present datum, as near as can be learned, is 1.68 feet below the original datum. Owing to change in conditions of flow due to the relocation of the bridge piers it is, however, impossible to utilize the early measurements in studies of discharge curves under the present conditions. The datum of the present chain gage has remained the same since its establishment.

At low and medium stages measurements are made from a ferryboat at a point about 450 feet above the bridge. At high stages measurements are made from the bridge.

The bed of the river at the bridge is mainly rock, overlain in places with silt at low stages. At high stages the high velocity of the current scours out this silt, and the changes in conditions of flow necessitate new ratings at frequent intervals.

Discharge measurements of Green River at Greenriver, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 21	La Rue and Burridge	470	5,110	11.50	41,500
July 17	G. T. Burridge	478	4,850	10.80	36,600
August 3	do		3,890	8.70	22,500
August 28	La Rue and Burridge	453	3,200	7.20	11,400
1908.					
March 24	A. D. Williams	441	2,570	6.20	6,120
July 9	Hoyt and La Rue	470	3,750	8.00	14,800

Daily gage height, in feet, of Green River at Greenriver, Utah, for 1907 and 1908.

[George C. Mead and L. H. Green, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.6	4.5	6.4	6.7	7.8	10.65	11.6	8.85	6.6	5.5	5.3	4.7
2	4.55	4.45	6.25	6.55	7.9	10.45	11.6	8.65	6.6	5.35	5.3	4.6
3	4.5	4.4	6.25	6.35	8.05	10.4	11.55	8.5	6.6	5.3	5.3	4.7
4	4.45	4.4	6.05	6.15	8.05	10.4	11.7	8.4	6.6	5.4	5.3	4.65
5	4.4	4.5	5.85	6.1	7.95	10.85	11.8	8.35	6.85	5.6	5.3	4.6
6	4.4	4.65	5.7	5.85	7.8	11.35	12.0	8.2	6.5	5.65	5.3	4.6
7	4.25	4.7	5.55	5.85	7.75	11.9	12.1	8.1	6.45	5.7	5.3	4.5
8	4.1	5.0	5.6	6.2	7.65	12.15	12.2	8.0	6.4	5.7	5.3	4.5
9	4.25	5.25	5.45	6.55	7.6	12.45	12.2	8.0	6.4	5.6	5.3	4.5
10	4.4	5.6	5.2	6.65	7.45	12.7	12.1	7.9	6.3	5.6	5.2	4.5
11	4.4	6.1	5.2	6.85	7.45	12.9	12.1	7.7	6.2	5.75	5.2	4.4
12	4.4	6.35	5.25	6.95	7.65	12.85	12.0	7.65	6.1	5.9	5.2	4.4
13	4.3	6.1	5.3	6.9	7.9	12.7	11.85	7.5	6.0	6.0	5.2	4.4
14	4.3	5.8	5.3	7.15	8.75	12.45	11.55	7.5	5.95	6.15	5.2	4.4
15	4.3	5.6	5.2	7.75	9.15	12.2	11.35	7.45	5.9	6.15	5.2	4.4
16	4.4	5.5	5.2	8.1	9.3	11.9	10.95	7.4	5.9	5.95	5.1	4.3
17	4.4	5.55	5.2	8.5	9.3	11.75	10.7	7.25	5.85	5.75	5.1	4.3
18	4.35	5.4	5.1	8.85	9.15	11.65	10.45	7.1	5.8	5.6	5.05	4.3
19	4.3	5.4	5.0	9.0	9.0	11.5	10.1	7.0	5.65	5.6	5.0	4.3
20	4.25	5.4	5.0	9.3	9.0	11.5	9.75	6.95	5.6	5.5	5.0	4.3
21	4.35	5.4	5.0	9.25	9.55	11.55	9.55	6.85	5.6	5.45	5.0	4.2
22	4.45	5.75	6.0	8.95	10.55	11.5	9.35	6.8	5.5	5.4	4.9	4.2
23	4.2	5.95	5.2	8.6	11.1	11.5	9.15	6.7	5.5	5.4	4.9	4.2
24	4.1	6.0	6.2	8.2	11.6	11.4	9.0	6.65	5.5	5.4	4.9	4.2
25	4.0	5.65	7.4	8.0	11.95	11.4	9.0	6.7	5.4	5.4	4.8	4.2
26	3.85	5.8	7.5	7.95	12.15	11.3	9.0	6.75	5.4	5.4	4.8	4.2
27	4.05	5.85	7.5	7.8	12.05	11.4	9.0	7.15	5.4	5.4	4.7	4.3
28	4.2	6.25	7.4	7.8	12.2	11.45	9.0	7.0	5.4	5.4	4.7	4.3
29	4.35	.....	7.25	7.8	11.9	11.6	8.9	6.9	5.4	5.3	4.7	4.3
30	4.4	.....	7.05	7.8	11.4	11.6	8.9	6.8	5.4	5.3	4.7	4.3
31	4.5	.....	6.85	7.8	10.4	.....	8.8	6.7	.....	5.3	.....	4.3
1908.												
1	4.3	4.5	4.6	5.8	7.1	8.0	8.3	6.45	6.25	6.55	5.7	4.1
2	4.3	4.6	4.6	5.7	7.0	7.9	8.2	6.65	6.2	6.25	5.7	4.1
3	4.3	4.6	4.7	5.6	6.9	7.9	8.0	6.85	6.2	6.1	5.6	4.1
4	4.3	4.6	5.0	5.5	6.9	7.65	8.0	7.05	6.1	6.0	5.6	4.1
5	4.3	4.5	5.0	5.5	6.95	7.55	8.0	7.2	6.05	5.9	5.6	4.0
6	4.3	4.5	5.1	5.5	7.05	7.9	8.0	6.95	6.0	5.85	5.5	4.1
7	4.3	4.6	5.1	5.5	7.1	7.9	8.1	6.4	5.85	5.8	5.5	4.25
8	4.3	4.6	5.1	5.5	7.15	8.0	8.1	6.25	5.65	5.7	5.4	4.4
9	4.3	4.65	5.1	5.5	7.2	7.9	8.0	6.2	5.6	5.7	5.4	4.55
10	4.3	4.7	5.2	5.5	7.35	8.0	8.0	7.0	5.5	5.6	5.3	4.6
11	4.3	4.6	5.2	5.5	7.45	7.9	8.0	6.7	5.4	5.6	5.3	4.7
12	4.3	4.6	5.2	5.5	7.6	8.05	7.95	6.2	5.4	5.6	5.3	4.8
13	4.3	4.5	5.2	5.5	7.95	8.35	7.95	6.35	5.3	5.6	5.3	4.8
14	4.3	4.6	5.3	5.65	8.05	8.9	7.85	7.0	5.3	5.6	5.3	4.8
15	4.3	4.6	5.3	5.85	8.1	9.0	7.65	6.85	5.3	5.5	5.2	4.8

Daily gage height, in feet, of Green River at Greenriver, Utah, for 1907 and 1908.—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16	4.3	4.6	5.5	6.1	8.0	9.4	7.6	6.85	5.2	5.5	5.15	4.7
17	4.3	4.5	5.95	6.2	7.7	9.5	7.6	6.9	5.2	5.5	5.1	4.5
18	4.3	4.5	6.0	6.35	7.6	9.6	7.5	6.9	5.2	5.65	5.0	4.4
19	4.4	4.5	5.8	6.55	7.5	9.6	7.4	6.8	5.2	5.9	5.0	4.3
20	4.5	4.5	5.7	6.75	7.5	9.7	7.3	6.8	5.1	6.15	4.9	4.3
21	4.55	4.5	5.85	7.05	7.6	9.7	7.2	6.9	5.0	6.15	4.8	4.3
22	4.65	4.5	6.1	7.35	7.75	9.6	7.1	6.9	6.3	6.0	4.8	4.3
23	4.6	4.6	6.35	7.55	7.85	9.5	7.0	6.9	5.9	5.9	4.9	4.3
24	4.5	4.6	6.2	7.75	7.9	9.65	7.0	6.8	5.8	5.8	4.9	4.3
25	4.5	4.6	6.1	7.8	8.05	9.5	6.9	6.75	6.2	5.8	5.1	4.3
26	4.5	4.7	6.1	7.8	7.8	9.35	6.65	6.7	6.0	5.8	5.1	4.3
27	4.5	4.7	6.0	7.65	7.75	9.1	6.55	6.7	5.7	5.8	5.2	4.3
28	4.6	4.6	5.85	7.55	7.95	9.0	6.4	6.65	5.85	5.7	5.2	4.3
29	4.6	4.6	5.75	7.45	8.05	8.75	6.2	6.6	5.9	5.7	5.1	4.3
30	4.6	.....	5.7	7.25	8.0	8.6	6.45	6.5	6.35	5.7	4.15	4.3
31	4.6	.....	5.7	.....	8.0	.....	6.2	6.35	.....	5.7	.....	4.3

Rating tables for Green River at Greenriver, Utah.

JANUARY 1, 1906, TO MAY 24, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.60	1,510	4.90	3,870	6.20	8,550	8.00	18,900
3.70	1,640	5.00	4,150	6.30	9,010	8.20	20,340
3.80	1,770	5.10	4,440	6.40	9,480	8.40	21,840
3.90	1,910	5.20	4,740	6.50	9,960	8.60	23,420
4.00	2,050	5.30	5,060	6.60	10,450	8.80	25,080
4.10	2,200	5.40	5,390	6.70	10,950	9.00	26,780
4.20	2,360	5.50	5,740	6.80	11,470	9.20	28,500
4.30	2,530	5.60	6,100	6.90	12,000	9.40	30,240
4.40	2,720	5.70	6,480	7.00	12,550	9.60	32,000
4.50	2,920	5.80	6,870	7.20	13,700	9.80	33,800
4.60	3,140	5.90	7,270	7.40	14,910	10.00	35,600
4.70	3,370	6.00	7,680	7.60	16,180	11.00	45,040
4.80	3,610	6.10	8,110	7.80	17,510	12.00	55,000

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1906 and the form of the 1905 curve. It is well defined between gage heights 4.5 and 10.0 feet.

MAY 25, 1907, TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.s-ft.*
4.00	1,270	5.30	3,360	6.60	7,790	8.80	20,820
4.10	1,390	5.40	3,590	6.70	8,250	9.00	22,250
4.20	1,520	5.50	3,840	6.80	8,730	9.20	23,700
4.30	1,650	5.60	4,120	6.90	9,220	9.40	25,190
4.40	1,780	5.70	4,420	7.00	9,730	9.60	26,710
4.50	1,920	5.80	4,730	7.20	10,780	9.80	28,260
4.60	2,060	5.90	5,050	7.40	11,880	10.00	29,850
4.70	2,210	6.00	5,400	7.60	13,030	11.00	38,300
4.80	2,370	6.10	5,760	7.80	14,220	12.00	47,900
4.90	2,540	6.20	6,140	8.00	15,450	13.00	58,600
5.00	2,730	6.30	6,530	8.20	16,740		
5.10	2,930	6.40	6,930	8.40	18,070		
5.20	3,140	6.50	7,350	8.60	19,430		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907 and 1908 and the form of previous curves. It is well defined above gage height 6.0 feet.

Monthly discharge of Green River at Greenriver, Utah, for 1907 and 1908.

[Drainage area, 38,200 square miles.]

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
1907.							
January	3,140	1,840	2,580	0.068	0.08	159,000	C.
February	9,240	2,720	5,660	.148	.15	314,000	C.
March	15,500	4,150	7,800	.204	.24	480,000	C.
April	29,400	7,070	16,200	.424	.47	964,000	C.
May	51,000	15,200	29,200	.764	.88	1,800,000	C.
June	57,500	33,100	44,600	1.17	1.30	2,650,000	A.
July	50,000	20,800	35,800	.937	1.08	2,200,000	A.
August	21,200	8,020	12,500	.327	.38	769,000	B.
September	8,980	3,590	5,430	.142	.16	323,000	B.
October	5,950	3,360	4,110	.108	.12	253,000	C.
November	3,300	2,210	2,910	.076	.08	173,000	C.
December	2,210	1,520	1,770	.046	.05	109,000	C.
The year	57,500	1,520	14,000	.368	4.99	10,200,000	
1908.							
January	2,140	1,650	1,790	.047	.05	110,000	C.
February	2,210	1,920	2,030	.053	.06	117,000	C.
March	6,730	2,060	4,040	.106	.12	248,000	C.
April	14,200	3,840	7,380	.193	.22	439,000	A.
May	16,100	9,220	13,000	.340	.39	799,000	A.
June	27,500	12,700	20,400	.534	.60	1,210,000	A.
July	17,400	6,140	12,400	.325	.37	762,000	A.
August	10,800	6,140	8,370	.219	.25	515,000	A.
September	6,730	2,730	4,560	.119	.13	271,000	B.
October	7,570	3,840	4,810	.126	.15	296,000	B.
November	4,420	1,460	3,210	.084	.09	191,000	C.
December	2,370	1,270	1,760	.046	.05	108,000	C.
The year	27,500	1,270	6,980	.183	2.48	5,070,000	

COLORADO RIVER AT HARDYVILLE, ARIZ.

This station, which is located one-quarter mile above the deserted town of Hardyville and 7 miles above Fort Mohave, Ariz., was established May 11, 1905, and was discontinued October 1, 1907. It was maintained in cooperation with the State of California.

The bed of the stream is composed of cemented gravel and changes gradually as the river falls from flood stage to low water, a bar forming in that portion of the section nearest the right bank and altering conditions of flow materially. The right bank is composed of cemented gravel, is high and not subject to overflow; the left bank is made up of alluvial material, easily eroded, is low and wooded, and is liable to overflow at flood stages. Discharge measurements are made from a car and cable. The datum of the staff gage, which has remained the same since the establishment of the station, is at elevation 507.18 feet above sea level. The gage is located 275 feet below the cable from which discharge measurements are made.

Discharge measurements of Colorado River at Hardyville, Ariz., in 1907.

[By Carvin, Fackles, and Somers.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 5	6.95	9,270	April 6	9.15	22,300	July 6	15.30	104,000
January 12	6.56	7,410	April 13	9.36	24,800	July 13	14.40	100,000
January 19	6.88	8,890	April 20	12.28	42,500	July 18	13.00	64,200
January 26	6.69	7,910	April 28	10.92	35,200	July 20	12.9	57,200
February 2	6.89	8,260	May 4	10.45	31,600	July 27	11.2	50,800
February 9	7.30	10,500	May 11	9.95	26,900	August 3	10.65	45,900
February 16	7.30	10,500	May 18	10.60	38,300	August 10	9.72	44,100
February 23	7.45	11,600	May 25	13,45	67,900	August 17	8.80	27,200
March 2	7.69	14,200	June 1	14.40	65,600	August 24	8.60	23,400
March 9	8.11	14,900	June 8	13.78	65,300	September 1	8.60	21,800
March 16	7.59	15,000	June 11	15.38	110,000	September 8	8.40	22,300
March 23	7.80	14,200	June 22	15.40	104,000	October 6	7.20	13,400
March 30	9.78	29,200	June 29	14.70	81,000			

Daily gage height, in feet, of Colorado River at Hardyville, Ariz., for 1907.

[Marion Derrick, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6.65	6.8	7.7	9.8	10.2	14.4	14.8	11.05	8.5
2	6.85	6.9	7.7	9.7	10.2	14.0	14.6	10.8	8.45
3	6.75	6.8	.....	9.5	10.2	13.2	15.0	10.65	8.9
4	6.9	6.8	7.8	9.5	10.45	.....	15.1	10.2	9.2
5	6.95	6.9	8.0	9.4	10.55	13.0	15.0	10.7	8.85
6	7.0	7.3	7.9	9.15	10.55	12.9	15.3	10.5	8.9
7	6.9	7.25	8.25	9.15	10.5	13.0	15.1	10.4	8.8
8	6.8	7.2	8.2	9.05	10.4	13.8	15.0	10.15	8.8
9	6.7	7.3	8.1	9.05	10.4	14.3	15.0	9.7	8.6
10	6.7	7.3	8.0	9.2	10.2	14.7	14.8	9.7	.....
11	6.6	7.3	8.3	9.3	10.0	15.35	14.7	9.45	8.1
12	6.55	.....	8.1	9.3	9.85	15.5	14.7	9.25	8.05
13	6.6	7.4	8.0	9.4	9.8	15.45	14.4	9.15	7.95
14	6.6	7.35	7.85	9.65	9.85	15.3	14.2	9.0	7.85
15	6.7	7.35	7.7	9.9	9.75	15.0	14.0	8.9	7.65
16	6.8	7.3	7.65	10.5	10.0	15.1	13.7	8.9	7.55
17	6.9	7.3	7.55	11.25	10.15	15.3	13.35	8.8	7.4
18	.....	7.4	7.5	11.8	10.65	15.0	13.0	8.75	7.5
19	6.9	7.5	7.6	12.05	11.1	15.4	13.2	8.7	7.6
20	6.85	7.6	7.5	12.35	11.3	15.4	12.9	8.6	7.35
21	6.75	7.45	.....	12.5	11.3	15.2	12.65	8.4	7.15
22	6.7	7.4	7.5	12.35	11.5	15.4	11.9	8.3	7.2
23	6.75	7.45	7.8	12.3	11.8	15.05	11.6	8.2	7.2
24	6.7	7.9	7.7	12.2	12.4	15.4	11.2	8.6	7.3
25	6.65	7.6	7.65	.....	13.6	14.8	10.9	.....	7.35
26	6.65	7.5	8.5	11.35	14.5	14.85	11.05	8.9	7.4
27	6.7	7.4	9.0	10.95	15.5	14.7	11.2	8.1	.....
28	6.65	7.9	9.6	10.75	15.0	14.7	10.9	8.0	7.35
29	6.65	.....	9.5	10.5	14.9	14.7	11.15	7.9	7.1
30	6.5	.....	9.6	10.3	14.4	14.7	11.1	8.5	7.05
31	6.65	.....	9.8	.....	.....	.....	11.1	8.75	.....

Daily discharge, in second-feet, of Colorado River at Hardyville, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	7,800	7,900	14,100	28,600	29,400	65,600	86,200	50,000	21,400
2	8,800	8,260	14,200	27,500	29,400	61,000	84,600	47,300	21,200
3	8,300	7,850	14,300	25,700	29,500	52,300	93,200	45,900	24,800
4	9,100	7,850	14,400	25,400	31,600	52,100	96,000	42,500	25,800
5	9,270	8,300	15,400	24,400	32,400	52,000	95,500	18,600	25,200
6	9,600	10,500	14,400	22,300	32,400	52,000	104,000	47,700	25,600
7	9,000	10,200	16,400	22,500	31,800	54,000	102,000	47,600	25,000
8	8,550	9,900	15,800	21,900	30,900	65,700	102,000	46,400	25,000
9	8,000	10,500	14,900	22,000	30,700	77,300	104,000	43,000	23,600
10	8,000	10,500	14,600	23,300	29,000	89,500	102,000	44,100	22,000
11	7,500	10,500	17,100	24,100	27,100	110,000	102,000	40,000	20,000
12	7,410	10,800	16,200	24,300	26,900	112,000	105,000	36,600	19,600
13	7,600	11,000	16,100	25,200	27,400	110,000	100,000	34,200	19,000
14	7,600	10,800	15,600	25,800	28,600	106,000	93,400	31,800	18,200
15	8,000	10,800	15,200	26,800	28,600	98,500	87,500	30,000	16,900
16	8,500	10,500	15,400	30,700	31,800	100,000	80,000	29,000	16,200
17	9,000	10,600	14,400	36,000	33,600	104,000	74,500	27,200	15,300
18	8,950	11,100	13,800	40,000	38,700	96,700	64,200	25,600	16,000
19	8,900	11,700	14,200	41,800	42,800	106,000	64,000	26,000	16,400
20	8,700	12,200	13,200	43,000	44,400	105,000	57,200	24,800	14,800
21	8,200	11,400	13,000	45,600	44,000	100,000	56,300	23,000	13,600
22	7,900	11,300	12,600	44,900	45,600	104,000	49,500	22,900	13,900
23	8,200	11,600	14,200	45,000	48,700	95,000	47,700	21,700	13,800
24	7,900	14,400	13,800	44,600	55,000	102,000	45,300	23,400	14,400
25	7,700	12,900	13,500	41,500	70,200	87,500	44,000	24,600	14,600
26	7,700	12,400	19,000	37,800	83,500	87,500	47,800	25,200	14,900
27	7,850	12,000	22,700	35,100	102,000	83,800	50,800	19,200	14,900
28	7,500	15,100	27,400	33,800	87,300	82,200	47,600	18,400	14,700
29	7,400	.....	26,800	31,900	82,000	81,000	50,800	17,500	13,000
30	6,700	.....	27,800	30,200	70,400	82,600	50,200	21,600	12,700
31	7,300	.....	29,000	.....	67,500	.....	50,400	20,600	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Colorado River at Hardyville, Ariz., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	9,600	6,700	8,160	502,000	B.
February	15,100	7,850	10,800	600,000	B.
March	29,000	12,600	16,800	1,030,000	B.
April	45,600	21,900	31,700	1,890,000	B.
May	102,000	26,900	44,900	2,760,000	B.
June	112,000	52,000	85,900	5,110,000	B.
July	104,000	44,000	75,300	4,630,000	B.
August	50,000	17,500	32,500	2,000,000	B.
September	25,800	12,700	18,400	1,090,000	B.
The period				19,600,000	

COLORADO RIVER AT YUMA, ARIZ.

This station, which is located in the town of Yuma, Ariz., 1½ miles below the mouth of Gila River, and 10 miles by river above the Mexican border, furnishes information concerning the amount of water available for irrigation along lower Colorado River and for diversion at the Laguna dam (Pl. V, *A*). Records of river height have been kept by the Southern Pacific Railroad Company since April 1, 1878.

The records given herewith are furnished by the United States Reclamation Service, through F. L. Sellew, project engineer, Yuma.

As the bed of the stream is composed of silt and sand and is very unstable, frequent measurements are necessary to properly define the daily discharge. The right bank is low, wooded, and liable to overflow; the left bank is not subject to overflow. Previous to May 31, 1903, discharge measurements were made from the railroad bridge. On that date a cable station was established at a point 600 feet below the bridge, and all measurements are now made from a car, except during highest floods, when a boat is used. At flood stages a large part of the water flows through an old channel and does not pass under the cable. At such times this overflow water is measured at the point where it passes under the railway trestle, one-third mile north of the main channel.

During the flood of May and June, 1905, there were two breaks in the railroad grade at Araz, Cal., 4 miles from Yuma, and the water passing through these is included in each discharge measurement of the Colorado.

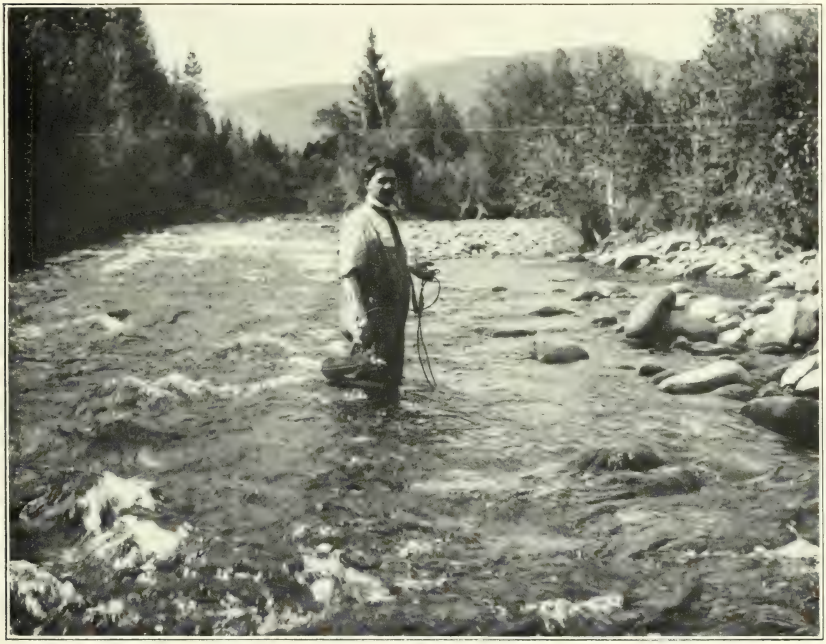
The staff gage is in two sections, located at the railroad bridge, 600 feet above the cable station, the upper section reading above 24 feet being the original gage established in 1876. The elevation of the zero of the gage is 137.4 feet above sea level.

Discharge measurements of Colorado River at Yuma, Ariz., in 1907 and 1908.

[By Robertson, North, Dyer, and Priest.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
January 1	22.75	36,600	March 25	22.0	26,200	June 12	27.1	81,800
January 3	20.85	24,700	March 27	21.5	20,200	June 15	28.05	94,400
January 5	20.6	18,800	March 30	23.0	31,200	June 17	28.55	101,000
January 7	20.2	15,200	April 1	22.8	29,000	June 19	29.15	106,000
January 9	20.0	15,900	April 3	23.2	32,100	June 22	29.05	108,000
January 11	20.7	18,200	April 6	22.7	29,200	June 24	28.9	112,000
January 14	22.0	29,700	April 8	22.4	27,400	June 26	28.9	114,000
January 16	20.5	20,400	April 10	22.2	24,700	June 29	28.6	115,000
January 18	19.8	16,300	April 13	22.45	25,900	July 1	28.3	113,000
January 21	21.7	27,300	April 15	22.5	26,000	July 6	27.4	107,000
January 23	20.6	22,100	April 17	23.0	29,500	July 8	27.5	108,000
January 25	20.15	15,900	April 20	24.8	41,500	July 10	27.8	110,000
January 28	19.7	13,200	April 22	25.55	46,900	July 15	27.8	114,000
January 30	19.6	12,700	April 24	25.8	49,900	July 17	27.5	110,000
February 2	22.05	29,500	April 27	25.6	45,700	July 20	26.75	102,000
February 4	21.6	27,100	April 29	24.7	44,600	July 22	25.65	92,000
February 6	20.6	18,800	May 1	23.75	35,500	July 24	24.8	82,400
February 8	20.4	17,900	May 4	23.2	32,400	July 29	23.1	58,600
February 11	20.9	20,300	May 6	23.1	33,000	July 31	22.8	55,400
February 13	20.6	17,400	May 8	23.3	33,900	August 3	23.3	61,900
February 16	20.5	16,600	May 11	23.2	32,800	August 5	22.85	55,300
February 18	20.4	14,900	May 13	22.8	30,400	August 7	22.45	50,600
February 20	20.2	14,100	May 15	22.65	29,100	August 10	22.15	49,900
February 23	21.0	17,400	May 18	22.8	28,600	August 12	21.45	41,300
February 25	20.7	15,000	May 20	23.5	31,900	August 14	20.95	33,900
February 28	21.9	22,900	May 22	24.4	37,500	August 17	20.45	32,900
March 2	20.75	16,700	May 25	24.7	41,300	August 19	20.25	28,600
March 5	21.0	18,000	May 27	25.55	51,000	August 22	20.25	26,800
March 9	24.65	46,200	May 29	27.0	61,800	August 24	19.95	24,500
March 11	22.2	26,500	June 1	28.4	72,400	August 26	20.5	27,300
March 13	21.75	24,900	June 3	29.1	77,000	August 29	20.3	25,000
March 16	21.2	19,700	June 6	28.95	87,100	August 31	19.6	23,100
March 18	20.8	16,900	June 8	27.75	80,100	September 2	22.25	43,300
March 20	20.4	14,800	June 10	26.9	72,200	September 4	21.25	35,000

A. INTAKE GATES ON CALIFORNIA SIDE OF LAGUNA DAM, YUMA PROJECT, ARIZONA.



B. MEASURING SECTION ON WHITEROCKS RIVER NEAR WHITEROCKS, UTAH.

Discharge measurements of Colorado River at Yuma, Ariz., in 1907 and 1908—Continued.

[By Robertson, North, Dyer, and Priest.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
September 7	21.25	34,500	February 14	20.0	14,900	August 12	21.8	28,200
September 9	20.75	31,900	February 19	19.7	12,900	August 14	21.05	24,000
September 11	20.5	27,600	February 21	19.9	10,600	August 17	20.6	20,700
September 14	19.65	21,900	February 24	19.7	9,900	August 19	20.4	20,500
September 16	19.2	18,400	February 26	20.65	16,900	August 21	20.45	19,300
September 21	19.0	15,500	March 3	20.25	11,700	August 24	22.4	33,800
September 23	19.0	14,100	March 9	22.2	27,000	August 26	22.1	28,200
September 25	19.0	13,400	March 11	21.1	18,700	August 28	21.6	25,000
September 28	19.1	13,400	March 12	21.9	24,700	August 31	20.65	18,900
October 1	18.9	12,000	March 14	20.6	15,200	September 2	20.4	19,200
October 3	18.8	11,300	March 17	20.05	13,400	September 4	20.1	16,600
October 5	18.7	10,300	March 19	19.85	11,300	September 7	19.6	14,100
October 8	18.75	10,300	March 23	20.2	13,200	September 11	19.3	11,800
October 10	19.1	12,200	March 25	20.45	14,300	September 17	19.1	10,400
October 12	19.7	15,900	March 28	20.95	17,200	September 19	18.8	8,900
October 14	19.75	15,500	March 31	20.8	16,100	September 21	18.7	8,200
October 17	19.6	14,000	April 2	20.8	16,400	September 23	18.65	7,700
October 19	19.5	13,800	April 6	20.4	13,900	September 25	18.6	7,000
October 21	19.55	14,600	April 9	20.2	13,400	September 28	18.8	7,500
October 23	19.95	15,900	April 17	20.6	13,600	September 30	18.8	7,200
October 26	19.5	14,200	April 22	21.1	16,500	October 3	18.9	6,600
October 28	20.25	18,800	April 25	22.0	27,100	October 5	19.4	8,200
October 30	19.9	16,300	April 27	21.95	26,000	October 7	19.5	8,500
November 2	19.55	14,300	April 29	22.05	28,100	October 9	19.8	10,000
November 4	19.4	12,900	May 2	22.7	29,800	October 12	19.5	8,600
November 6	19.3	11,900	May 5	22.0	27,100	October 14	19.8	9,900
November 9	19.1	11,800	May 9	21.4	23,100	October 19	19.3	7,700
November 12	19.1	10,900	May 13	21.65	25,100	October 23	19.4	8,200
November 14	19.1	10,700	May 16	21.55	23,500	October 26	21.15	20,600
November 18	18.8	9,600	May 18	22.2	27,900	October 28	20.05	13,700
November 20	18.8	9,900	May 22	22.3	27,500	October 30	19.75	12,100
November 23	18.8	9,600	May 26	22.15	25,500	November 2	19.3	9,900
November 26	18.7	9,100	May 31	22.8	31,300	November 4	19.2	9,200
November 29	18.7	9,000	June 5	22.6	30,900	November 6	19.3	8,500
December 2	18.5	8,600	June 8	22.4	33,600	November 9	19.3	8,200
December 5	18.3	7,800	June 12	23.3	35,200	November 11	19.4	8,200
December 7	18.3	8,000	June 15	23.3	38,700	November 13	19.5	8,700
December 9	18.3	7,500	June 17	23.3	39,400	November 16	19.5	8,000
December 12	18.3	7,900	June 19	24.35	48,300	November 18	19.6	7,600
December 14	18.5	7,700	June 22	24.95	55,100	November 20	19.6	7,500
December 16	18.45	7,300	June 24	25.25	59,700	November 23	19.55	7,300
December 18	18.4	7,300	June 26	25.35	61,700	November 25	19.7	7,200
December 21	18.4	7,400	June 29	24.6	55,400	November 27	19.7	7,400
December 24	18.35	7,500	July 1	24.5	53,800	November 30	19.2	6,000
December 28	18.15	6,300	July 4	24.2	53,100	December 2	19.2	6,200
December 30	18.1	6,000	July 6	23.8	49,300	December 4	19.4	6,600
			July 8	23.05	41,100	December 7	19.6	7,400
1908.			July 10	22.3	35,400	December 9	19.6	7,700
January 2	18.0	5,800	July 13	21.9	31,200	December 11	19.55	7,400
January 5	18.2	6,400	July 15	21.5	29,800	December 12	19.5	7,300
January 8	18.6	7,400	July 17	21.2	28,800	December 14	19.4	6,900
January 11	18.4	6,900	July 20	21.0	25,600	December 16	19.1	6,100
January 13	18.3	6,700	July 22	20.7	24,600	December 17	19.4	7,300
January 16	18.2	5,900	July 24	20.7	24,100	December 19	27.1	72,500
January 18	18.1	5,600	July 27	20.55	21,600	December 20	27.3	68,900
January 20	18.1	5,600	July 29	20.1	19,300	December 22	21.5	25,400
January 27	18.4	6,300	July 31	20.2	18,900	December 23	23.1	37,200
January 30	18.4	6,100	August 3	20.85	22,700	December 26	20.6	19,400
February 5	18.7	7,400	August 5	20.7	21,400	December 28	19.8	14,800
February 7	23.95	45,000	August 7	21.1	25,200	December 30	19.2	11,200
February 11	19.7	14,200	August 10	22.05	31,900			

Daily gage height, in feet, of Colorado River at Yuma, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	22.95	19.55	20.85	22.85	23.75	28.45	28.3	23.1	20.65	18.9	19.9	18.6
2	21.2	21.55	20.8	22.9	23.45	28.9	28.05	23.1	22.25	18.9	19.55	18.5
3	20.9	22.4	21.25	23.2	23.3	29.1	27.65	23.3	21.6	18.8	19.4	18.5
4	20.7	21.5	21.0	23.05	23.2	29.2	27.4	23.05	21.2	18.65	19.4	18.4
5	20.6	21.1	21.1	22.8	23.1	29.15	27.4	22.85	21.55	18.7	19.35	18.3
6	20.3	20.65	21.25	22.75	23.15	28.9	27.35	22.5	21.5	18.7	19.3	18.3
7	20.2	20.55	22.85	22.65	23.25	28.3	27.35	22.45	21.25	18.75	19.2	18.3
8	19.9	20.6	27.0	22.35	24.3	27.7	27.5	22.45	20.65	18.75	19.2	18.3
9	20.0	20.95	24.55	22.2	23.3	27.25	27.7	22.3	20.75	19.0	19.1	18.3
10	20.7	21.0	23.2	22.2	23.2	26.85	27.8	22.15	21.0	19.1	19.15	18.3
11	20.7	20.9	22.3	22.4	23.15	26.95	28.05	21.85	20.5	19.1	19.1	18.3
12	23.7	20.75	21.7	22.5	23.0	27.15	28.0	21.45	20.0	19.7	19.1	18.3
13	23.3	20.6	21.85	22.45	22.85	27.45	28.05	21.25	19.65	19.7	19.1	18.4
14	22.0	20.5	21.8	22.5	22.65	27.75	27.95	20.95	19.65	19.75	19.1	18.5
15	21.1	20.55	21.35	22.5	22.65	28.05	27.8	20.65	19.35	19.4	19.0	18.4
16	20.5	20.5	21.15	22.8	22.75	28.25	27.65	20.5	19.2	19.4	18.9	18.45
17	19.95	20.4	20.9	23.05	22.7	28.55	27.5	20.45	19.15	19.6	18.8	18.45
18	19.8	20.4	20.7	23.5	22.8	28.85	27.45	20.3	19.05	19.65	18.8	18.4
19	21.4	20.35	20.55	24.25	23.0	29.1	27.1	20.25	18.95	19.5	18.8	18.35
20	22.85	20.2	20.4	24.8	23.6	29.15	26.75	20.1	18.9	19.35	18.8	18.4
21	21.5	20.55	20.4	25.15	24.1	29.15	26.1	20.3	19.0	19.55	18.85	18.4
22	21.0	21.25	20.4	25.5	24.45	29.1	25.65	20.25	19.25	19.2	18.8	18.5
23	20.6	20.95	20.4	25.75	24.6	29.0	25.3	20.1	19.0	19.95	18.8	18.5
24	20.3	20.75	20.55	25.85	24.7	28.9	24.85	19.95	19.0	19.9	18.8	18.35
25	20.1	20.7	22.3	25.85	24.75	28.9	24.3	20.2	19.0	19.8	18.7	18.3
26	20.0	21.4	22.3	25.75	25.05	28.85	23.6	20.5	19.0	19.5	18.7	18.3
27	19.8	21.85	21.5	25.6	25.5	28.75	23.25	20.4	19.05	19.4	18.6	18.3
28	19.7	21.3	21.7	25.3	26.15	28.7	23.0	20.5	19.1	20.25	18.65	18.15
29	19.6	.....	22.95	24.8	27.5	28.6	23.1	20.3	19.25	19.7	18.7	18.1
30	19.6	.....	23.0	24.3	27.95	28.4	22.8	19.9	19.05	19.9	18.6	18.1
31	19.6	.....	23.05	.....	.....	.....	22.8	19.6	.....	20.25	.....	18.0
1908.												
1	18.0	18.5	20.3	20.75	22.7	22.85	24.5	20.35	20.4	18.8	19.4	19.2
2	18.0	18.5	20.25	20.8	22.7	22.75	24.45	20.8	20.4	18.8	19.3	19.2
3	18.1	18.6	20.25	20.7	22.55	22.6	24.25	20.95	20.3	19.0	19.2	19.4
4	18.2	18.7	20.85	20.5	22.3	22.6	24.1	20.6	20.05	19.3	19.2	19.4
5	18.4	18.75	21.0	20.4	22.0	22.6	23.9	20.75	19.8	19.6	19.25	19.55
6	18.45	19.7	20.7	20.4	21.75	22.3	23.75	21.1	19.65	19.7	19.25	19.6
7	18.55	23.8	20.65	20.25	21.55	22.3	23.35	21.2	19.55	19.55	19.3	19.6
8	18.6	21.4	23.05	20.1	21.4	22.5	23.05	21.55	19.5	19.75	19.3	19.6
9	18.6	20.45	22.2	20.2	21.35	22.7	22.7	22.25	20.05	19.8	19.3	19.6
10	18.55	19.75	21.4	20.05	21.4	22.95	22.3	22.0	19.5	19.6	19.4	19.6
11	18.4	19.7	21.45	20.1	21.55	23.2	22.1	21.8	19.25	19.5	19.4	19.5
12	18.3	19.7	21.9	20.25	21.7	23.3	22.0	21.7	19.2	19.5	19.5	19.5
13	18.3	19.95	21.0	20.45	21.65	23.5	21.85	21.0	19.4	19.65	19.5	19.5
14	18.3	20.0	20.6	20.6	21.6	23.5	21.7	21.15	19.1	19.7	19.5	19.3
15	18.2	19.95	20.55	20.65	21.45	23.3	21.4	20.65	19.05	19.45	19.5	19.2
16	18.2	19.9	20.3	20.7	21.55	23.2	21.3	20.5	19.9	19.35	19.55	19.1
17	18.1	19.8	20.05	20.6	21.95	23.3	21.2	20.6	19.25	19.25	19.6	19.3
18	18.1	19.7	19.9	20.65	22.2	23.8	21.05	20.35	18.9	19.25	19.6	19.65
19	18.1	19.7	19.85	20.7	22.25	24.3	21.0	20.4	18.8	19.3	19.6	20.25
20	18.1	19.8	19.8	20.8	22.3	24.6	21.0	20.2	18.75	19.3	19.6	20.25
21	18.1	19.9	19.8	20.8	22.3	24.75	20.9	20.45	18.7	19.3	19.6	21.5
22	18.1	20.05	20.1	21.1	22.3	25.0	20.7	20.8	18.75	19.3	19.6	21.3
23	18.1	19.75	20.2	21.7	22.2	25.2	20.55	21.3	18.65	19.35	19.6	23.05
24	18.2	19.7	20.35	21.95	22.0	25.2	20.7	22.45	18.6	19.4	19.75	22.1
25	18.2	19.95	20.45	22.0	22.0	25.25	20.7	22.35	18.6	20.05	19.7	21.15
26	18.35	20.65	20.75	21.95	22.15	25.3	20.7	22.05	18.6	21.05	19.7	20.5
27	18.4	20.8	20.9	21.95	22.5	25.15	20.5	21.8	18.65	20.5	19.7	20.1
28	18.45	20.7	20.95	22.0	22.9	24.8	20.2	21.45	18.8	20.05	19.6	19.75
29	18.5	20.4	20.9	22.05	23.0	24.55	20.1	20.85	18.8	19.75	19.45	19.45
30	18.5	.....	20.85	22.45	22.9	24.55	20.2	20.9	18.85	19.7	19.2	19.15
31	18.4	.....	20.8	.....	22.75	.....	20.25	20.6	.....	19.6	.....	18.85

Daily discharge, in second-feet, of Colorado River at Yuma, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	38,400	12,400	17,200	29,300	35,500	72,900	113,000	57,500	31,100	12,000	16,300	8,800
2	26,900	25,700	16,900	29,900	32,600	76,200	111,000	58,500	43,300	11,600	14,300	8,600
3	25,000	31,300	19,300	32,100	31,200	77,000	110,000	61,900	38,400	11,300	12,900	8,500
4	21,600	26,600	18,000	30,700	32,400	77,700	110,000	58,200	35,000	10,300	12,000	8,100
5	18,800	24,400	18,500	28,500	31,800	77,400	110,000	55,300	38,000	10,300	12,500	7,800
6	16,000	19,200	19,300	29,200	33,000	87,100	107,000	51,200	37,600	10,100	11,900	7,900
7	15,200	17,700	28,600	28,900	33,700	83,300	107,000	50,600	34,500	10,200	11,800	8,000
8	16,100	19,000	68,700	27,100	33,900	80,100	108,000	50,600	35,500	10,300	11,800	7,800
9	15,900	20,500	45,100	24,700	33,900	77,200	110,000	50,300	31,900	11,500	11,800	7,500
10	18,400	20,800	34,500	24,700	33,500	72,200	110,000	49,900	33,300	12,200	11,600	7,600
11	18,200	20,300	27,300	24,700	32,800	72,700	112,000	46,200	27,600	12,200	11,200	7,700
12	44,300	18,900	24,700	28,000	30,600	81,800	112,000	41,300	24,200	15,900	10,900	7,900
13	40,900	17,400	25,800	25,900	30,400	86,500	114,000	38,300	21,900	15,600	10,800	7,800
14	29,700	16,600	25,400	26,000	29,500	90,400	113,000	33,900	21,900	15,500	10,700	7,700
15	24,400	17,000	21,100	26,000	29,100	94,400	114,000	29,500	19,600	13,500	10,500	7,500
16	20,400	16,600	19,200	28,100	30,000	97,100	114,000	32,200	18,400	13,500	10,200	7,300
17	17,100	14,900	17,600	29,500	29,600	101,000	110,000	32,900	17,700	14,000	10,000	7,300
18	16,300	14,900	16,200	33,600	28,600	105,000	110,000	29,700	16,300	14,000	9,600	7,300
19	25,200	14,700	15,600	38,200	29,600	106,000	104,000	28,600	14,900	13,800	9,800	7,300
20	33,400	14,100	14,800	41,500	31,900	106,000	102,000	25,400	14,200	13,600	9,900	7,300
21	25,800	15,500	14,800	43,800	34,700	106,000	94,300	29,200	15,500	14,600	9,700	7,400
22	23,900	18,400	14,800	46,900	37,500	108,000	92,000	26,800	16,500	13,200	9,600	7,500
23	22,100	17,200	14,800	48,300	38,700	110,000	88,900	25,700	14,100	15,900	9,600	7,500
24	18,000	15,400	15,900	49,900	39,300	112,000	82,400	24,500	13,800	15,900	9,400	7,500
25	15,200	15,000	38,400	50,500	41,300	113,000	76,800	25,800	13,400	15,500	9,300	7,200
26	15,000	19,600	28,400	49,300	45,700	114,000	68,800	27,300	13,100	14,200	9,100	7,100
27	13,800	22,600	20,200	45,700	51,000	115,000	62,700	26,300	13,200	13,800	8,800	6,900
28	13,200	19,000	21,700	46,200	57,800	115,000	58,800	27,500	13,400	18,800	8,900	6,300
29	12,700	.....	30,800	44,600	61,800	115,000	58,600	25,000	14,000	15,500	9,000	6,100
30	12,700	.....	31,200	43,500	65,500	115,000	52,400	23,900	13,200	16,300	8,800	6,000
31	12,700	.....	31,600	.....	68,800	.....	55,400	23,100	.....	17,800	.....	5,800
1908.												
1	5,800	6,300	13,400	15,900	32,000	32,200	53,800	18,600	17,300	7,200	10,200	6,000
2	6,100	6,300	12,500	16,400	29,800	31,300	53,000	22,400	19,200	7,200	9,900	6,200
3	6,100	6,500	11,700	15,800	29,500	30,300	49,800	22,700	19,300	6,600	9,400	6,700
4	6,400	6,900	16,600	14,600	28,500	30,600	53,100	21,800	16,600	7,900	9,200	6,600
5	7,000	7,400	16,500	14,300	27,100	30,900	52,400	21,400	14,000	8,200	9,600	7,000
6	7,200	9,500	14,000	13,900	25,400	30,000	49,300	24,900	12,700	9,200	8,500	7,400
7	7,300	45,000	13,400	13,500	24,100	31,200	45,000	25,200	14,100	8,500	8,500	7,400
8	7,400	30,000	33,000	13,100	23,200	33,600	41,100	29,500	13,600	9,200	8,500	7,400
9	7,400	19,000	27,000	13,400	23,100	33,900	37,300	36,100	16,400	10,000	8,200	7,700
10	7,200	15,000	20,900	12,900	23,300	34,300	35,400	31,900	13,600	9,000	8,200	7,700
11	6,900	14,200	18,700	13,000	24,500	34,800	33,900	30,100	11,800	8,500	8,200	7,400
12	6,800	14,200	24,700	13,200	25,200	35,200	33,100	28,200	11,000	8,600	8,700	7,300
13	6,700	14,800	18,500	13,400	25,100	36,000	31,200	23,700	12,600	9,300	8,700	7,300
14	6,700	14,900	15,200	14,000	25,000	35,600	29,100	24,000	10,300	9,900	8,700	6,900
15	6,400	14,800	15,000	14,100	24,000	38,700	29,800	21,800	9,900	8,400	8,700	6,100
16	5,900	14,600	14,300	14,000	23,500	40,200	29,100	20,900	16,400	8,000	8,000	6,100
17	5,800	14,300	13,400	13,600	26,000	39,400	28,800	20,700	10,400	7,500	7,600	7,300
18	5,600	12,900	12,500	13,800	27,900	43,600	28,300	18,900	9,000	7,500	7,600	8,300
19	5,600	12,900	11,300	14,000	28,000	48,300	28,100	20,500	8,900	7,700	7,600	72,500
20	5,600	11,800	10,500	14,700	28,100	50,400	25,600	20,300	8,600	7,700	7,500	68,900
21	5,600	10,600	10,100	14,800	27,800	51,700	24,000	19,300	8,200	7,700	7,500	25,400
22	5,600	11,500	13,400	16,500	27,500	55,100	24,600	22,600	8,600	7,700	7,500	25,400
23	5,600	10,000	13,200	24,000	27,000	57,900	24,100	25,600	7,700	8,200	7,300	37,200
24	5,800	9,900	14,000	27,100	26,000	59,700	24,100	33,800	7,300	8,200	7,200	29,800
25	5,800	11,700	14,300	27,100	25,000	59,700	24,100	33,400	7,000	11,400	7,200	22,900
26	6,100	16,900	16,000	26,200	25,500	61,700	24,100	28,200	7,000	20,600	7,200	19,400
27	6,300	17,400	17,000	26,000	29,900	58,700	21,600	22,600	7,700	16,000	7,400	15,800
28	6,400	17,000	17,200	27,000	32,800	50,700	19,800	25,000	7,500	13,700	7,300	14,800
29	6,400	16,000	17,000	28,100	33,700	55,400	19,300	20,200	7,500	11,800	6,700	12,800
30	6,300	.....	16,800	35,000	32,800	55,000	19,800	20,500	7,200	12,100	6,000	11,200
31	6,100	.....	16,100	.....	31,300	.....	18,900	18,900	.....	11,300	.....	9,100

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Colorado River at Yuma, Ariz., for 1907 and 1908.

[Drainage area, 225,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	44,300	12,700	21,500	0.096	0.11	1,320,000	B.
February	31,300	12,400	18,800	.084	.09	1,040,000	B.
March	68,700	14,800	24,100	.107	.12	1,480,000	B.
April	50,500	24,700	35,300	.157	.18	2,100,000	B.
May	68,800	28,600	37,900	.168	.19	2,330,000	B.
June	115,000	72,200	94,800	.421	.47	5,640,000	B.
July	114,000	52,400	96,500	.429	.49	5,930,000	B.
August	61,900	23,100	37,600	.167	.19	2,310,000	B.
September	43,300	13,100	23,200	.103	.12	1,380,000	B.
October	18,800	10,100	13,600	.060	.07	836,000	B.
November	16,300	8,800	10,800	.048	.05	643,000	B.
December	8,800	5,800	7,450	.033	.04	458,000	B.
The year	115,000	5,800	35,100	.156	2.12	25,500,000	
1908.							
January	7,400	5,600	6,320	0.028	0.03	389,000	B.
February	45,000	6,300	14,200	.063	.07	817,000	B.
March	33,000	10,100	16,100	.072	.08	990,000	B.
April	35,000	12,900	17,800	.079	.09	1,060,000	B.
May	33,700	23,000	27,200	.121	.14	1,670,000	B.
June	61,700	30,000	42,900	.191	.21	2,550,000	B.
July	53,800	18,900	32,600	.145	.17	2,000,000	B.
August	36,100	18,600	24,300	.108	.12	1,490,000	B.
September	19,300	7,000	11,400	.051	.06	678,000	B.
October	20,600	6,600	9,510	.042	.05	585,000	B.
November	10,200	6,000	8,090	.036	.04	481,000	B.
December	72,500	6,000	15,900	.071	.08	978,000	B.
The year	72,500	5,600	18,900	.084	1.14	13,700,000	

SALTON SEA NEAR SALTON, CAL.

Salton Sea originally formed a part of the Colorado Desert, which has an area of nearly 2,000 square miles and extends in a northwesterly direction almost 100 miles from the California-Mexico boundary line. It comprises two fertile valleys, one to the northwest of the sink, in Riverside County, known as the Coachella Valley, and the other to the southeast of the sink, in Imperial County, called the Imperial Valley. Salton Sea, which now partly fills the sink, lies between the two valleys and is partly in Riverside County and partly in Imperial County. The longest diameter of the sea has a northwest-southeast direction. On December 31, 1908, its surface was 206 feet below mean sea level, and it had a length of nearly 45 miles, a maximum width of about 15 miles, a minimum width of 9.5 miles, a maximum depth of 67.5 feet, and a superficial area of about 443 square miles. It is about 160 miles southeast of Los Angeles, 90 miles northwest of Yuma, and 50 miles north of Calexico.

A few thousand years ago, according to geologic evidence, what is now Salton Sea was a part of the Gulf of California, which then

extended about 200 miles farther northwest than at present. It is probable that the gulf waters then swept inland to the base, or nearly to the base, of San Jacinto Peak, although all evidence which would enable us to fix its exact limits has been obliterated by still more recent geologic events. At that time the mouth of Colorado River was in the vicinity of Yuma, 60 miles in an air line north of its present location. Presumably, then, as now, it was discharging annually enough silt to cover 1 square mile to a depth of 53 feet with dry earth, equivalent to 1 cubic mile each century, cut from the great canyons in the upper Colorado and the Gila Valley and carried to the Gulf. Running water will carry in suspension matter that quickly settles in still water, the settling process in this case being aided by the clarifying effect of the salt water.

As a result of these processes the Colorado delta was gradually extended southwestward toward the Cocopa Mountains, and when it reached them it had separated the old gulf into the present gulf and an inland sea. Delta growth, however, did not cease with the separation of the water body into two parts. Silt continued to be brought down the stream and to be deposited in its bed, along its banks, and in the still waters at its mouth. A stream, by this process of deposition along its channel, eventually builds the channel up until it is higher than the lands adjacent on either side. It is then in a condition of unstable equilibrium, and at some favorable time, as during an exceptional flood, it will break out of its immediate banks and establish itself in some more favorable course. By this process, oft repeated, it comes eventually to flow over all parts of its delta, building up each part in succession. By such a process the Colorado must have discharged alternately into the gulf and into the depression now known as the Salton Sink, meanwhile building up the delta dam that separates them until it reached a height of about 40 feet above sea level. During this process it is highly probable that water filled the Salton depression and evaporated from it many times, for it must have quickly disappeared whenever the erratic river changed its course to the gulf, for the run-off from the mountains that surround the sink is too slight to maintain a permanent water body in this region of intense evaporation. Meanwhile the original body of salt water that occupied the sink had been displaced by the volumes of fresh water poured into it from the river, and in the intermediate stages of the lake's existence, at least, its water was fresh or nearly fresh. A clear and definite indication of the last occupancy of this depression by a lake, presumably just before the river had shifted its course that it now follows to the gulf, may be seen in the remarkably well preserved old water line that rims the desert from Indio to the Cerro Prieto at a height of 40 feet above sea level. On the rocky points that projected into

the lake it is marked by a thick deposit of calcium carbonate, by slightly cut sea cliffs, and by a change in the profile of the rocky spurs at the water line. Where alluvial cones and the sandy floor of the desert formed the shore line beaches have been developed, and although of soft sand and easily eroded, they are even now well preserved, thus testifying to the recency of the action that produced them. Over the floor of the desert and along the sandy beaches are myriads of shells of fresh or brackish water mollusks [a] that lived in the lake.

There are some reasons for thinking that the lake at this latest stage was not perfectly fresh, that its waters were at least distinctly "hard." Its area when it stood at 40 feet above sea level was somewhat in excess of 2,100 square miles. The average flow of the Colorado has been determined as about 11,000,000 acre-feet per annum. The evaporation from a surface of the area of the old lake, under the conditions that prevail here, has never been determined, but is undoubtedly high. If it is as high as 8 feet per annum, it would nearly equal the average annual inflow from the Colorado; if it is but 7 feet per annum, the average inflow would exceed the evaporation by 2,000 second-feet, or somewhat less than 14 per cent of the inflow. In either event, the waters of the lake would be markedly more alkaline after a term of years than those of the Colorado. The calcium carbonate incrustations on the rocky points about the shores of the old lake are best explained by supposing that the lake waters contained large quantities of this salt, so that wherever they broke in spray and evaporated more rapidly than usual, the carbonate was deposited. This necessary excess of inflow over outflow at the period of maximum area of the lake, taken in connection with the thick calcium carbonate incrustations on the shores, indicates distinctly hard water. It may be assumed that other salts than calcium carbonate were also present in large amount, for the conditions that would lead to the abundance of one salt would also lead to an abundance of the others. The shells so thickly distributed over the desert floor, however, are not salt-water forms, but are identical with those now found living in the springs and occasional permanent streams about the desert borders. Many of these springs and streams are somewhat brackish, and the creatures flourish in them. It seems probable, then, that the lake waters also were rather alkaline, perhaps even brackish, at the time the lake attained its maximum area.

The period at which this lake disappeared can not be precisely fixed. The time units of geology are too large and too indefinite to translate satisfactorily into years, so that when we say that the disappearance of the lake is the most recent of geologic events we still

[a] Stearns, Robt. E. C., Remarks on fossil shells from the Colorado Desert: Am. Naturalist, vol. 13, pp. 141–154.

leave the mind groping for a definite human standard of time. The sandy beaches which mark the borders of the ancient lake are cut away, to be sure, where washes cross them from the mountains, but in sheltered places they are still perfect. Where they stretch across an embayment from one rocky point to another they are mere embankments of sand, old barrier beaches, with depressions behind them once occupied by shallow lagoons. In other areas, where they contour the alluvial cones, they are gullied and cut away where streams have flowed across them, but in other places are preserved unscarred. At one locality noted a low sea cliff that had been cut in alluvial-fan material was still preserved, although the loose sand and bowlders would slump in a few heavy storms.

In a region of abundant rainfall such ephemeral forms as these would be more nearly obliterated within fifty years after the lake had disappeared than they are now in the desert. In such a region the precipitation is twenty times that of the desert. It is the crudest of estimates—merely a guess in fact—to state that, reasoning from geologic evidence alone, it may be a thousand years since the lake disappeared, yet it puts in concrete form such a guess as the geologist is able to make, and this guess may be correct within a margin of error of 50 per cent.

When human records are studied some evidence on this point is found, but it is almost as uncertain as to time as that furnished by the physical features. The Indians in the Coachella Valley have distinct legends to the effect that at some time in the past the valley was occupied by a large body of water. Professor Blake records that they told him of a time when a great body of water existed in which were many fish, and of the manner in which that water disappeared "poco á poco"—little by little—until the lake became dry.

The Indians now living in the desert put this event as far back as the lives of four or five very old men, say four or five centuries ago at the most. There are, of course, no records and there is no known check on this assertion. Statements by Indians as to time, beyond the limits spanned by their own memories, are notoriously inaccurate. Furthermore, we do not know the means used to procure this statement. The native races are usually very prone to follow the suggestions contained in leading questions, and so to give the answer desired by the questioner. To obtain an entirely independent and unguided answer is one of the most delicate of tasks. Yet their statement has some value, and combining the evidence of the physical conditions and the Indian legends it may be said that it is probable that the lake disappeared and left the desert, as we have known it in historical time, from five hundred to one thousand years ago.

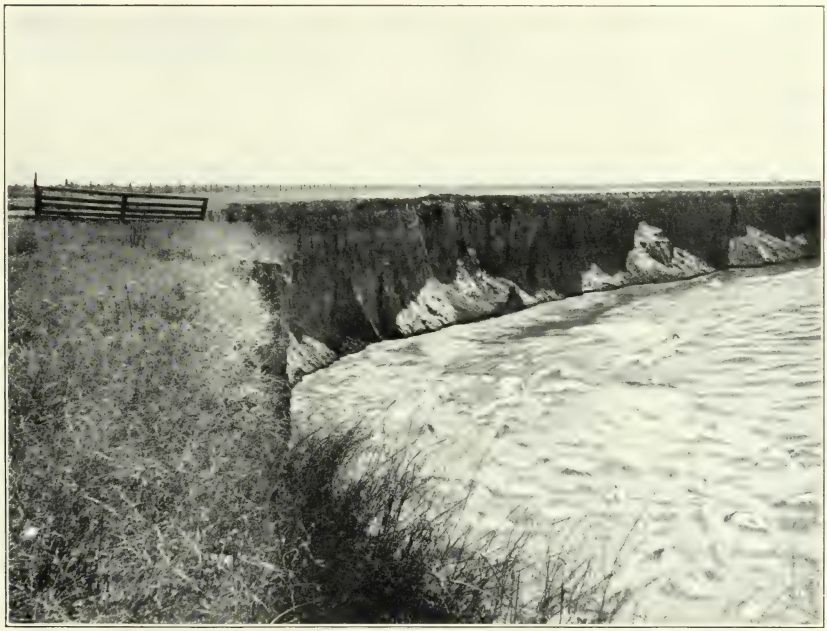
During the summer of 1891 the high water in the Colorado overflowed into Salton Sink to such an extent as to endanger the Southern

Pacific Railroad line at its lowest point. In the summer of 1905, after a succession of winter and spring floods in Gila River, followed by an exceptionally heavy summer flow in the Colorado, there was a repetition of flood conditions in the sink on a much larger scale.

The gravity of the situation on this latter date, however, was greatly augmented by the interference of man. For several years preceding a small quantity of water had been diverted from the Colorado below Yuma, Ariz., to be used by the settlers of the Imperial Valley for irrigation and domestic purposes. The first water was diverted in the United States and conveyed to the Imperial Valley, after passing through Mexican territory, by means of an old river channel which had been one of the Colorado's distributaries during the formation of its delta, and is now known as Alamo River. The increased demand for water and the silting up of the original canal heading above the boundary line necessitated the cutting of an additional channel from the river below the boundary to connect with the canal. It likewise silted up, and to supply the urgent need for water a canal was cut 4 miles below the original heading to connect Colorado and Alamo rivers. This canal was not provided with protective headworks and had a gradient much greater than that of the river, so that with the unusual and prolonged summer flood in 1905, it began cutting, until in July it was carrying 87 per cent of the total flow of the river. This large quantity of water flooded several hundred square miles about Calexico in the southern part of the Imperial Valley and caused serious loss both in the United States and in Mexico. These waters ultimately reached the Salton Sea, but in so doing they deepened and widened Alamo River into a great gorge and developed another drainage channel to the west through Imperial Valley in a second gorge now called New River (Pl. VI, *B*). Notwithstanding all attempts to control it the Colorado continued to pour its waters through Alamo and New rivers into Salton Sea until the early fall of 1906, when it was finally shut off by the Southern Pacific Company. It broke again, however, on December 7, but was closed about two months later.

The rise of Salton Sea began in November, 1904, and continued throughout 1905 and 1906 and until February, 1907. In the summer of 1905 it endangered the Southern Pacific tracks to such an extent as to require frequent shifting to higher ground by means of "shoo-fly" or spur tracks, which served temporarily until the latter part of the year when a high line about 40 miles in length was completed on the 200-foot contour below sea level. This line is still in use, though during the latter part of 1906 and the early part of 1907, the lower portion of it was seriously damaged by the action of waves. For use in the future, if required, another line has been located and graded

A. SALTON SEA NEAR SALTON STATION, SOUTHERN PACIFIC RAILROAD, 205 FEET BELOW SEA LEVEL, AUGUST 29, 1906.



B. NEW RIVER CUTTING BACK AND UNDERMINING ITS BANKS, CAUSING DESTRUCTION OF MANY ACRES OF FINE FARM LANDS.

on the 150-foot contour below sea level. In addition to the damage done to the railroad the sea has completely submerged the plant of the New Liverpool Salt Company, below Mecca, and also a few ranches in the vicinity of Mecca.

The gage record from November, 1904, to February 26, 1906, was kept by the New Liverpool Salt Company. Their datum is the lowest portion of the sink, or at least that portion which first filled with water, so that the gage record shows the actual depth of the water from time to time. On February 23, 1906, the Government put in a gage on the same datum about one-half mile west of Salton railway station, which is 3 miles southeast of the old Salton station (Pl. VI, *A*). This gage consisted of a series of five posts, 6 inches by 6 inches by 6 feet, set in the ground about 3 feet deep, and so placed that when the water covered one it would just reach the next one farther back. It was not a great while, however, until the waves completely destroyed this gage. In the meantime the Southern Pacific Company had graduated a bent on the trestle bridge across Salt Creek, about 2½ miles east of Salton, using the company's datum, and arrangements were made to have the Southern Pacific agent at Salton furnish the record from this gage, corrections being made to reduce the original datum. The zero of the gage is 273.5 feet below mean sea level as determined from United States Geological Survey bench marks, or at an elevation of −280.3 according to the Southern Pacific Company.

There is some uncertainty as to the elevation of the lowest point of Salton Sink, and it is now believed that the depth below sea level has been overestimated in the past. From the record of the depth of the water as it filled the lowest portion of the basin, as kept by the New Liverpool Salt Company, it appears that the maximum depth of water was 17 feet on October 4, 1905 (according to the gage and as checked by soundings later), when on the same date the water surface just covered the United States Geological Survey bench mark a few feet from the old Salton railway station. As this bench mark is 256.5 feet below mean sea level, it would appear that the lowest point of the sink is 273.5 feet below mean sea level instead of 287 feet, which has been accepted heretofore. In 1891 Southern Pacific engineers reported the lowest point in the sink as −280.2, which corresponds to −273.4, United States Geological Survey.

Practically all the water that enters Salton Sea discharges through Alamo and New rivers, chiefly through the former. These rivers run through Imperial Valley and are the drainage channels for all the excess and waste water from the irrigation system and from the power plants.

There was a large inflow to the sea during July and parts of June and August, 1907. The approximate inflow to the sea as determined

by discharge measurements made during the first half of 1908 is as follows:

	Second-feet.
January	500
February	400
March	200
April	200
May	200
June	125

Total inflow January 1 to June 30, 1908, 97,700 acre-feet, or sufficient to cover the surface of the sea about 0.34 foot deep.

During 1908 the following measurements were made on Alamo and New rivers by H. R. Edwards, engineer for the New Liverpool Salt Company.

Discharge measurements of Alamo River near Brawley, Cal., in 1908.

[By H. R. Edwards.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1908.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
January 7	6.6	632	March 9	5.9	300	April 28	5.0	115
January 8	6.5	519	March 11	5.3	152	April 30	5.5	188
January 10	6.4	573	March 13	5.0	100	May 2	5.6	181
January 13	6.6	542	March 14	5.3	190	May 4	5.4	174
January 15	6.2	416	March 16	5.2	141	May 6	5.8	214
January 17	6.2	379	March 18	4.8	88	May 8	5.8	242
January 20	6.2	374	March 22	5.5	105	May 10	5.1	102
January 23	6.2	383	March 23	5.1	117	June 21	6.0	394
January 26	6.4	428	March 24	5.6	186	June 22	5.5	254
January 27	6.6	438	March 25	5.8	253	June 23	5.3	168
January 29	6.6	496	March 27	5.5	198	June 24	5.5	220
January 31	6.5	411	March 29	5.7	254	June 26	6.2	417
February 2	6.5	395	March 31	5.0	93	June 27	5.9	331
February 4	7.3	697	April 5	5.8	258	June 28	5.9	307
February 6	6.8	585	April 7	5.0	96	June 29	5.7	268
February 10	5.9	270	April 9	4.4	52	June 30	5.5	222
February 12	6.1	357	April 11	4.6	65	July 1	5.7	274
February 14	5.4	142	April 13	4.9	90	July 2	5.2	163
February 23	4.2	39	April 15	5.0	107	July 3	5.2	155
February 25	6.0	312	April 17	5.2	122	July 4	6.4	520
February 27	5.8	256	April 19	5.9	275	July 6	6.7	589
February 29	5.9	309	April 20	6.1	355	July 7	6.1	401
March 2	6.0	412	April 22	6.1	377	July 8	5.6	228
March 4	6.1	337	April 24	6.4	432			
March 6	5.9	266	April 26	5.1	142			

Discharge measurements of New River near Brawley, Cal., in 1908.

[By H. R. Edwards.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
February 23		44	April 13		40
March 23		36	June 22		26
April 5		39			

Daily gage height, in feet, of Salton Sea near Salton, Cal., for 1907 and 1908.

[J. A. Jeffrey, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	72.6	75.4	76.0	75.9	.....	75.1	74.7	74.5	74.2	73.5	73.1	72.6
2	72.7	75.5	76.0	75.9	.....	75.1	74.7	74.5	74.2	73.4	73.1	72.6
3	72.8	75.6	76.0	75.9	.....	75.1	74.6	74.5	74.2	73.4	73.1	72.6
4	72.9	75.6	76.0	75.9	.....	75.1	74.6	74.5	74.2	73.3	73.0	72.5
5	72.9	75.7	76.0	75.9	.....	75.1	74.6	74.5	74.1	73.3	73.0	72.5
6	73.0	75.7	76.0	75.9	.....	75.1	74.6	74.5	74.1	73.3	73.0	72.5
7	73.0	75.8	76.0	75.9	.....	75.1	74.6	74.5	74.0	73.2	73.0	72.5
8	73.1	.....	76.0	75.9	.....	75.1	74.6	74.4	73.9	73.2	73.0	72.5
9	73.1	.....	76.0	75.9	.....	75.1	74.6	74.4	73.9	73.2	73.0	72.5
10	73.2	76.0	76.0	75.9	.....	75.0	74.6	74.4	73.8	73.2	73.0	72.5
11	73.4	76.0	76.0	75.9	.....	75.0	74.6	74.4	73.8	73.2	73.0	72.5
12	73.5	76.0	76.0	75.9	.....	75.0	74.6	74.4	73.8	73.1	72.9	72.5
13	73.6	76.0	76.0	75.8	.....	75.0	74.6	74.4	73.8	73.1	72.9	72.4
14	73.7	76.0	76.0	75.7	.....	75.0	74.6	74.4	73.8	73.1	72.9	72.4
15	73.8	76.0	76.0	75.7	75.4	75.0	74.6	74.4	73.8	73.1	72.9	72.4
16	73.9	76.0	76.0	75.7	75.4	75.0	74.6	74.4	73.7	73.1	72.9	72.4
17	74.0	76.0	76.0	75.7	75.4	75.0	74.6	74.4	73.7	73.1	72.9	72.4
18	74.1	76.0	76.0	.....	75.3	74.9	74.6	74.4	73.7	73.1	72.8	72.4
19	74.2	76.0	76.0	.....	75.2	74.9	74.6	74.3	73.6	73.1	72.8	72.4
20	74.3	76.0	76.0	.....	75.2	74.9	74.6	74.3	73.6	73.2	72.8	72.4
21	.....	76.0	76.0	.....	75.2	74.9	74.6	74.3	73.6	73.2	72.8	72.4
22	.....	76.0	76.0	.....	75.2	74.9	74.6	74.3	73.6	73.2	72.7	72.4
23	.....	76.0	76.0	.....	75.1	74.9	74.6	74.3	73.6	73.2	72.7	72.4
24	.....	76.0	76.0	.....	75.1	74.8	74.6	74.3	73.6	73.2	72.7	72.4
25	74.9	76.0	76.0	.....	75.1	74.8	74.6	74.3	73.5	73.2	72.7	72.4
26	75.0	76.0	76.0	.....	75.1	74.8	74.6	74.3	73.5	73.2	72.7	72.4
27	75.2	76.0	76.0	.....	75.1	74.7	74.6	74.3	73.5	73.2	72.6	72.3
28	75.3	76.0	76.0	.....	75.1	74.7	74.5	74.2	73.5	73.2	72.6	72.3
29	75.3	.....	76.0	.....	75.1	74.7	74.5	74.2	73.5	73.2	72.6	72.3
30	75.3	.....	75.9	.....	75.1	74.7	74.5	74.2	73.5	73.1	72.6	72.3
31	75.3	.....	75.9	.....	75.1	.....	74.5	.....	.....	73.1	.....	72.3
1908.												
1	72.3	72.3	72.2	71.9	71.6	71.0	70.5	70.1	69.4	68.6	67.9	67.6
2	72.3	72.3	72.2	71.9	71.6	71.0	70.5	70.1	69.3	68.6	67.9	67.6
3	72.3	72.3	72.2	71.9	71.5	70.9	70.5	70.0	69.3	68.5	67.9	67.6
4	72.3	72.3	72.2	71.9	71.5	70.9	70.5	70.0	69.3	68.5	67.9	67.6
5	72.3	72.3	72.1	71.9	71.5	70.9	70.4	70.0	69.3	68.5	67.9	67.6
6	72.3	72.3	72.1	71.9	71.5	70.9	70.4	70.0	69.3	68.5	67.9	67.6
7	72.3	72.4	72.1	71.9	71.4	70.9	70.4	69.9	69.3	68.5	67.9	67.6
8	72.3	72.4	72.1	71.8	71.4	70.8	70.4	69.9	69.2	68.4	67.9	67.6
9	72.3	72.4	72.1	71.8	71.4	70.8	70.4	69.9	69.2	68.4	67.8	67.5
10	72.3	72.3	72.1	71.8	71.4	70.8	70.4	69.9	69.2	68.4	67.8	67.5
11	72.3	72.3	72.1	71.8	71.4	70.8	70.3	69.9	69.2	68.4	67.9	67.5
12	72.3	72.3	72.1	71.8	71.3	70.8	70.3	69.8	69.2	68.4	67.9	67.5
13	72.3	72.3	72.1	71.8	71.3	70.8	70.3	69.8	69.1	68.4	67.8	67.5
14	72.3	72.3	72.1	71.8	71.3	70.8	70.3	69.8	69.1	68.4	67.8	67.5
15	72.3	72.3	72.1	71.8	71.3	70.8	70.3	69.8	69.1	68.3	67.8	67.5
16	72.3	72.3	72.1	71.8	71.3	70.7	70.3	69.7	69.1	68.3	67.8	67.5
17	72.3	72.3	72.1	71.7	71.2	70.7	70.3	69.7	69.1	68.3	67.8	67.5
18	72.3	72.3	72.1	71.7	71.2	70.7	70.3	69.7	69.0	68.2	67.8	67.4
19	72.3	72.2	72.1	71.7	71.2	70.7	70.2	69.6	69.0	68.2	67.8	67.4
20	72.3	72.2	72.1	71.7	71.2	70.7	70.2	69.6	69.0	68.1	67.8	67.4
21	72.3	72.2	72.1	71.7	71.2	70.6	70.2	69.6	69.0	68.1	67.8	67.4
22	72.3	72.2	72.0	71.7	71.2	70.6	70.2	69.6	68.9	68.1	67.8	67.4
23	72.3	72.2	72.0	71.6	71.1	70.6	70.2	69.6	68.9	68.1	67.8	67.4
24	72.3	72.2	72.0	71.6	71.1	70.6	70.2	69.6	68.9	68.0	67.7	67.4
25	72.3	72.2	72.0	71.6	71.1	70.6	70.2	69.5	68.8	68.0	67.7	67.4
26	72.3	72.2	72.0	71.6	71.1	70.6	70.1	69.5	68.8	68.0	67.7	67.4
27	72.3	72.2	72.0	71.6	71.1	70.5	70.1	69.5	68.7	68.0	67.6	67.4
28	72.3	72.2	72.0	71.6	71.1	70.5	70.1	69.5	68.7	68.0	67.6	67.4
29	72.3	.....	72.0	71.6	71.1	70.5	70.1	69.4	68.7	67.9	67.6	67.4
30	72.3	.....	72.0	71.6	71.1	70.5	70.1	69.4	68.6	67.9	67.6	67.4
31	72.3	.....	72.0	.....	71.0	.....	70.0	69.4	.....	67.9	.....	67.4

Monthly rise of Salton Sea near Salton, Cal., for 1904–1908.

Month.	Monthly rise.	Total rise.	Month.	Monthly rise.	Total rise.	Month.	Monthly rise.	Total rise.
1904.	*Feet.*	*Feet.*	1906.	*Feet.*	*Feet.*	1907.	*Feet.*	*Feet.*
November	0.6		March	2.7	28.3	September	−.7	73.5
December	.2	0.8	April	5.6	33.9	October	−.4	73.1
			May	8.6	42.5	November	−.5	72.6
1905.			June	15.4	57.9	December	−.3	72.3
January	1.4	2.2	July	8.6	66.5			
February	1.6	3.8	August	2.9	69.4	1908.		
March	.8	4.6	September	.9	70.3	January	.0	72.3
April	1.2	5.8	October	1.2	71.5	February	−.1	72.2
May	1.0	6.8	November	−.2	71.3	March	−.2	72.0
June	2.2	9.0	December	1.2	72.5	April	−.4	71.6
July	4.4	13.4				May	−.6	71.0
August	2.2	15.6	1907.			June	−.5	70.5
September	1.2	16.8	January	2.8	75.3	July	−.5	70.0
October	1.4	18.2	February	.7	76.0	August	−.6	69.4
November	1.6	19.8	March	−.1	75.9	September	−.8	68.6
December	2.9	22.7	April	−.3	75.6	October	−.7	67.9
			May	−.5	75.1	November	−.3	67.6
1906.			June	−.4	74.7	December	−.2	67.4
January	1.1	23.8	July	−.2	74.5			
February	1.8	25.6	August	−.3	74.2			

DUCHESNE RIVER DRAINAGE BASIN.

DESCRIPTION.

Duchesne River rises in the high peaks of the Uinta and Wasatch mountains in northwestern Utah, flows for about 100 miles in a general southeasterly direction, and enters Green River at Ouray, Utah, about 3 miles above the mouth of White River. The stream has a total drainage area of 4,000 square miles. Altitudes range from 4,700 feet at the mouth of the river to more than 13,000 feet at the summits of the highest peaks.

The principal tributaries of the Duchesne are Strawberry River, Rock (East) Creek, Lake Fork, and Uinta River.

The drainage basin of the upper Duchesne proper is mountainous in character. The stream emerges from the mountains at the mouth of Rock Creek, at an elevation of about 6,000 feet. From the mouth of Strawberry River down to Lake Fork the valley of the Duchesne is about 2 miles in average width, and is bordered by sandstone bluffs approximately 200 feet high. The bluffs on the northern side of the river are capped by heavy deposits of coarse river gravel and cobblestones. The general course of the stream throughout this stretch and on down to the mouth of the Uinta is easterly. Along the lower course of the stream the plateaus on either side of the stream valley are comparatively low and can be easily reached by irrigation canals from the main stream.

Strawberry River, the main upper tributary of the Duchesne, drains an area of about 1,200 square miles. The stream rises in the Uinta Mountains, and enters the Duchesne at Theodore. Its flow is derived chiefly from melting snow, except during the late summer, when the flow comes from small springs well distributed over the entire drainage basin. The upper stream basin has numerous tributaries, particularly from the north and west. Among the most im-

portant may be mentioned Indian, Bryant's Fork, Mud, Horse, Sugar Springs, and Co-op. They are all short and fall rapidly until they reach Strawberry Valley, through which they flow sluggishly in well defined channels. The main stream traverses the valley from north to south and is very sluggish. Indian Creek drains a small portion of the southern slopes of the Uinta Mountains. Its basin comprises smooth, rolling hills, fairly well timbered with pine and aspen. The normal flow is derived chiefly from springs. The greater part of the precipitation is in the form of snow, which covers the ground for six or eight months of each year. As it has an average elevation of 7,500 feet, Strawberry Valley is not well suited for agricultural development, but is excellently adapted to grazing. At the mouth of the river, about 35 miles below Strawberry Valley, the elevation is about 5,500 feet, and the fall in that distance is, therefore, nearly 2,000 feet.

Rock Creek, Lake Fork, Uinta and its most important tributary, the Whiterocks, head in a series of small lakes in the Uinta Mountains. These lakes are fed by snow that exists the year round in the canyons and on the high slopes. All these streams drain areas mountainous and difficult of access in their upper portions, and all of them emerge from their canyons at an elevation of about 7,000 feet. Rock Creek continues its course in a narrow valley, but the others spread out so that their valleys are comparatively wide, and the adjoining benches comparatively low.

The drainage area of the Duchesne includes about 1,400 square miles of forest reserve, of which about 1,000 square miles may be classed as timbered land with an average stand of over 3,000 feet board measure to the acre. The principal species of timber are Engelmann spruce and lodgepole pine. The timbered land is distributed through the areas of the various tributaries about as follows: Upper Duchesne, 120 square miles; Rock Creek, 130 square miles; Strawberry River, 380 square miles; Lake Fork, 190 square miles; Uinta (above Whiterocks), 120 square miles; Whiterocks, 70 square miles.

Little information is avaliable as to the precipitation in this basin. In the plains portion of the area, the average rainfall is probably less than 10 inches, while the middle portion comprising considerably over one-half the area, probably averages between 10 and 15 inches. Only a small part in the high mountains has an annual precipitation in excess of 20 inches. At Fort Duchesne, at an elevation of 5,000 feet, a record extending over several years shows a mean annual rainfall of only 7 inches.

Very severe winters are experienced throughout this whole drainage basin. In the high mountains the snowfall is very heavy, and in many places the snow lies throughout the whole year. In the hills above an elevation of 7,000 feet there is very considerable snowfall, which usually forms in drifts in canyons, and not infrequently the snow lies for extended periods in the valleys and plateaus of the

more open country. All the streams in this drainage are usually covered with thick ice from about December 1 to April 1 of each year.

During the last three or four years this section, especially that included within the former limits of the Uinta Reservation, has undergone a great irrigation development. The United States Indian Service has constructed a series of canal systems diverting water from Lake Fork, the Uinta, and Whiterocks, and the Duchesne proper. Private enterprise has also taken hold, and although the private canal systems now in operation are small, eventually several hundred thousand acres of land below an elevation of 6,500 feet will be brought under irrigation. Practically no storage is used in connection with any of the irrigation systems now in operation or under construction, and excellent opportunities for additional development still remain.

The United States Reclamation Service is constructing a tunnel, with capacity of 500 second-feet, which will divert water from a 100,000-acre reservoir on the upper Strawberry across the divide to the headwaters of the Spanish Fork, there to be used for irrigation.

As the mountain drainage areas of all the main tributaries are studded with lakes, numerous reservoir sites can easily be found where water can be stored for the irrigation of the valley lands. It is believed that the entire flow from the drainage basin can be equalized by storage.

At the present time there are no water-power plants in this drainage basin, though with proper storage a development of 200,000 horsepower could be made. Very little water will be diverted for irrigation above an elevation of 6,500 feet, and as most of the reservoir sites are at an elevation of upward 8,000 feet, good opportunities for power development exist above irrigation diversions. Some of the streams have falls of from 100 to 150 feet or more per mile along these stretches.

At the present time the water in these streams is unused except for irrigation.

None of the records of stream flow in this basin extend back of 1899, and they are not continuous since that time. The driest year for which records are available was 1900, although 1902 was almost as low. The year of greatest average run-off was 1907.

DUCHESNE RIVER AT MYTON, UTAH.

This station, which was established October 26, 1899, and has been in operation every year, or portions thereof since that time, is located at the highway bridge at Myton, Utah, and was described in the earlier reports as the Price Road Bridge station. The object of the station is to determine the amount of water available for storage and irrigation.

The station is situated about 3 miles below the mouth of Lake Fork and about 15 miles above the mouth of the Uinta River, and the records show practically the entire run-off of the Duchesne basin above the mouth of Uinta River.

Within the last few years numerous ditches have been built by the United States Indian Service to divert water from this stream and its tributaries for irrigation on the Uinta Reservation. Water is also diverted for irrigation outside the limits of the reservation by several private parties.

Results at this station are affected by ice conditions for about four months during the winter season, and it is usually out of the question to apply open channel ratings for any portion of that time. The discharge has also been more or less affected by eddies about the wooden crib piers and by drift lodged against them.

The datum of the gage remained practically constant from the establishment of the station until June 6, 1909. (See Water-Supply Paper 269.)

Results at this station have been fairly good.

Discharge measurements of Duchesne River at Myton, Utah, 1905 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 13	H. S. Reed	95	366	5.22	330
March 14	do	95	363	5.20	317
April 19	do	105	394	5.41	443
1907.					
April 10	I. I. Price	102	598	6.04	814
April 25	do	104	665	7.10	1,870
May 14	do	107	728	7.90	2,880
May 29	do	107	806	8.35	3,910
June 12	do	108	851	8.82	4,650
June 29	do	109	981	9.90	7,340
July 19	do	106	874	8.50	3,930
August 15	do	104	678	6.75	1,490
September 2	do	104	666	6.52	1,330
September 14	do	104	628	6.10	844
September 16	Freeman, Fletcher, and Price	103	640	6.03	757
September 30	R. H. Fletcher	101	620	5.94	732
October 15	do	102	630	5.95	705
October 30	do	102	564	5.90	672
November 13	do	101	613	5.80	572
November 22[a]	do	101	602	5.68	497
December 9[a]	do	106	626	5.60	497
1908.					
March 18[b]	R. H. Fletcher	102	624	5.80	621
March 24	do	102	604	5.60	498
April 6	do	103	583	5.57	457
April 14	do	103	631	5.91	696
April 27	do	103	630	6.28	915
May 13	do	104	783	6.68	1,160
May 21	do	104	682	6.81	1,280
June 5	do	100	657	6.60	956
June 21	do	106	825	8.00	2,500
June 29	do	105	793	7.87	2,270
July 9	do	103	705	6.73	1,530
July 23	do	101	605	5.93	676
July 31	Freeman and Fletcher	106	683	6.39	1,000
August 6	R. H. Fletcher	101	639	6.25	965
August 17	do	100	626	5.93	737
August 25	do	100	586	5.93	717
September 10	do	101	589	5.70	555
September 15	do	101	601	5.77	634
September 30	do	101	595	5.75	616
October 9	do	101	611	5.90	704
October 17	do	101	608	6.03	764
October 29	do	101	584	5.80	629
November 11	do	100	575	5.65	554
November 19	do	100	571	5.62	508
December 3[a]	do	99	580	5.64	564
December 10[a]	do	99	581	5.50	559

[a] Ice conditions. [b] Ice out of stream.

Daily gage height, in feet, of Duchesne River at Myton, Utah, for 1905.

[H. Calvert, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.										
1		5.12	5.98	7.65	6.30			5.45	5.20	
2		5.14	6.02	8.10	7.20			5.50	5.20	
3		5.12	6.00	8.25	7.20			5.35	5.20	
4		5.12	6.00	8.55	6.95			5.30	5.20	
5		5.12	5.98	8.55	6.70			5.30	5.20	
6		5.12	5.92	8.40	6.20			5.30	5.20	
7		5.14	5.80	8.49	5.88			5.30	5.20	
8		5.15	5.80	8.70	5.85			5.30	5.20	
9		5.16	5.80	9.00	5.80			5.30	5.20	
10		5.33	5.80	8.35	5.80			5.30	5.20	
11		5.50	5.85	7.90	5.75			5.30	5.20	
12		5.38	5.80	8.05	5.74			5.30	5.20	
13	5.20	5.30	5.80	8.30	5.69			5.28	5.20	
14	5.20	5.30	5.80	8.45	5.65			5.28	5.20	
15	5.20	5.31	5.76	8.25	5.75			5.28	5.20	
16	5.20	5.36	5.74	8.00	5.85			5.28	5.20	
17	5.25	5.40	5.82	7.75	5.80			5.28	5.20	
18	5.25	5.40	5.95	7.35	5.70			5.28	5.20	
19	5.25	5.40	6.25	7.20	5.65			5.28	5.20	
20	5.28	5.40	6.50	7.45	5.60			5.25	5.22	
21	5.21	5.42	6.60	7.60	5.50			5.25	5.25	
22	5.20	5.48	6.85	7.41	5.50			5.25	5.30	
23	5.20	5.54	7.25	7.45				5.25	5.28	
24	5.20	5.62	7.05	7.20			5.15	5.25	5.25	
25	5.20	5.70	7.10	7.20			5.20	5.22	5.22	
26	5.20	5.78	7.02	7.20			5.10	5.20	5.20	
27	5.20	6.00	7.10	6.95			5.10	5.20	5.20	
28	5.15	5.95	7.25	6.75			5.00	5.20	5.20	
29	5.12	5.92	7.25	6.58			6.10	5.20		
30	5.12	5.90	7.19	6.50			6.10	5.20		
31	5.15		7.28					5.20		

NOTE.—Ice conditions prior to March 13 and after November 28, 1905. These records were omitted from the 1905 report through an oversight.

Daily gage height, in feet, of Duchesne River at Myton, Utah, for 1907 and 1908.

[H. G. Clarke and Alice Todd, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1			7.48	8.15	10.12	7.50	6.65	5.90	5.90	5.70
2			7.35	8.45	10.25	7.50	6.50	5.90	5.88	5.70
3			7.30	8.80	10.35	7.45	6.42	5.90	5.85	5.70
4			7.18	9.15	10.48	7.50	6.38	5.90	5.85	5.75
5			7.20	9.45	10.62	7.35	6.55	5.90	5.82	5.80
6			7.22	9.62	10.65	7.22	6.50	5.98	5.80	5.80
7			7.15	9.70	10.55	7.18	6.50	6.05	5.80	5.80
8			7.10	9.58	10.42	7.05	6.32	6.05	5.80	5.75
9			7.08	9.45	10.32	6.90	6.22	6.00	5.80	5.70
10		6.05	7.18	9.15	10.05	6.70	6.20	5.95	5.80	5.70
11		6.25	7.35	8.90	9.82	6.78	6.15	5.95	5.80	5.70
12		6.62	7.60	8.95	9.55	6.72	6.15	5.95	5.80	5.70
13		6.90	7.85	9.08	9.45	6.70	6.10	5.95	5.80	5.70
14		7.20	7.85	8.82	9.32	6.70	6.10	5.95	5.75	5.75
15		7.45	7.65	8.58	9.08	6.70	6.05	5.95	5.70	5.80
16		7.62	7.50	8.35	8.85	6.65	6.00	5.95	5.70	
17		7.65	7.65	8.25	8.58	6.65	6.00	5.92	5.70	
18		7.62	7.92	8.35	8.50	6.50	6.00	5.90	5.70	
19		7.52	8.25	8.60	8.50	6.55	5.95	5.90	5.70	
20		7.40	8.58	9.15	8.60	6.55	5.95	5.90	5.70	
21		7.10	8.98	9.50	8.70	6.50	5.95	5.90	5.70	
22		7.00	9.18	9.52	6.45	6.42	5.95	5.90	5.70	
23		6.90	9.40	9.40	8.20	6.40	5.95	5.90	5.70	
24		7.10	9.40	9.25	8.10	6.40	5.90	5.90	5.70	
25		7.30	9.25	9.05	8.20	6.40	5.90	5.95	5.70	

[a] See footnote at end of table, next page.

Daily gage height, in feet, of Duchesne River at Myton, Utah, for 1907 and 1908—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
26		7.28	9.05	9.15	8.30	6.52	5.90	5.90	5.70	.....
27		7.30	8.72	9.40	8.05	6.50	5.90	5.90	5.70	.....
28		7.52	8.45	9.72	8.00	6.55	5.90	5.90	5.70	.....
29		7.58	8.28	9.88	7.82	6.52	5.90	5.90	5.70	.....
30		7.55	8.10	10.00	7.70	65.5	5.90	5.90	5.70	.....
31		.....	8.02	.....	7.52	6.52	.....	5.90	.....	.....
1908.										
1		5.55	6.2	6.85	7.55	7.5	5.5	5.75	5.8	5.6
2		5.5	6.25	6.8	7.35	6.75	5.5	5.75	5.85	5.6
3		5.5	6.45	6.7	7.3	6.5	5.55	5.8	5.75	5.6
4		5.5	6.75	6.6	7.2	6.25	5.5	6.0	5.75	5.65
5		5.55	6.7	6.55	7.2	6.15	5.45	5.9	5.7	5.7
6		5.55	6.65	6.55	7.15	6.2	5.45	5.85	5.7	5.6
7		5.7	6.6	6.5	6.95	6.3	5.45	5.85	5.7	5.6
8		5.7	6.8	6.55	6.85	6.2	5.5	5.85	5.7	5.5
9		5.65	6.95	6.6	6.7	6.15	5.7	5.9	5.65	5.5
10		5.65	6.9	6.95	6.65	6.05	5.7	5.9	5.65	5.55
11		5.65	6.8	7.7	6.65	6.05	5.65	5.9	5.6	5.6
12		5.7	6.7	8.6	6.55	6.05	5.65	5.95	5.6	5.6
13		5.8	6.65	9.0	6.5	6.0	5.7	5.95	5.6	5.5
14		5.9	6.55	9.15	6.45	6.15	5.8	5.9	5.6	5.5
15		6.05	6.5	9.25	6.45	6.05	5.75	5.9	5.55	5.55
16		6.1	6.45	9.0	6.4	5.95	5.65	6.0	5.5	5.5
17		6.2	6.45	8.45	6.35	5.9	5.6	6.0	5.6	5.5
18	5.8	6.15	6.5	8.1	6.2	5.9	5.6	6.0	5.6	5.5
19	5.75	6.3	6.6	7.8	6.1	5.9	5.55	6.0	5.6	5.4
20	5.6	6.55	6.8	7.65	6.05	6.0	5.55	5.95	5.6	5.25
21	5.6	6.8	6.8	8.0	6.0	5.9	5.5	5.9	5.6	5.1
22	5.6	6.85	6.75	8.55	5.95	5.9	5.5	5.8	5.6	5.15
23	5.6	6.8	6.7	8.45	5.9	6.55	5.45	5.8	5.55	5.25
24	5.6	6.6	6.6	8.35	5.95	6.1	5.7	5.8	5.6	5.45
25	5.6	6.5	6.6	8.5	5.9	5.9	6.1	5.8	5.5	5.65
26	5.6	6.45	6.85	8.45	5.85	5.8	6.0	5.8	5.5	5.7
27	5.6	6.3	7.0	8.5	5.9	5.75	5.8	5.8	5.5	5.75
28	5.6	6.25	6.9	8.15	6.15	5.7	5.8	5.8	5.5	5.85
29	5.5	6.25	6.8	7.85	6.45	5.65	5.75	5.8	5.55	6.0
30	5.5	6.15	6.7	7.75	6.6	5.6	5.75	5.8	5.55	6.05
31	5.5	.....	6.75	.....	6.4	5.55	.....	5.8	.....	6.2

NOTE.—Ice conditions prior to March 10 and during December, 1907. River open March 18, 1908. Ice conditions during December, 1908.

Rating tables for Duchesne River at Myton, Utah.

1904 TO 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.00	219	5.90	760	6.80	1,650	7.70	2,880
5.10	264	6.00	840	6.90	1,770	7.80	3,040
5.20	313	6.10	920	7.00	1,890	7.90	3,205
5.30	366	6.20	1,005	7.10	2,020	8.00	3,375
5.40	423	6.30	1,100	7.20	2,150	8.20	3,715
5.50	484	6.40	1,200	7.30	2,290	8.40	4,070
5.60	548	6.50	1,305	7.40	2,430	8.60	4,430
5.70	615	6.60	1,415	7.50	2,575	8.80	4,790
5.80	685	6.70	1,530	7.60	2,725	9.00	5,150

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1906 and is fairly well defined between gage heights 5.3 feet and 8.2 feet.

Rating tables for Duchesne River at Myton, Utah—Continued.

1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.70	525	6.80	1,560	7.90	3,010	9.00	5,050
5.80	595	6.90	1,680	8.00	3,160	9.20	5,520
5.90	670	7.00	1,800	8.10	3,320	9.40	6,000
6.00	750	7.10	1,920	8.20	3,490	9.60	6,510
6.10	835	7.20	2,050	8.30	3,660	9.80	7,050
6.20	925	7.30	2,180	8.40	3,840	10.00	7,610
6.30	1,020	7.40	2,310	8.50	4,020	10.20	8,190
6.40	1,120	7.50	2,440	8.60	4,210	10.40	8,790
6.50	1,230	7.60	2,580	8.70	4,410	10.60	9,410
6.60	1,340	7.70	2,720	8.80	4,620	10.80	10,030
6.70	1,450	7.80	2,860	8.90	4,830		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 17 discharge measurements made during 1907 and is well defined.

MARCH 18 TO APRIL 19, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.50	430	5.80	620	6.00	770	6.20	940
5.60	485	5.90	690	6.10	850	6.30	1,030
5.70	550						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 4 discharge measurements made during March and April, 1908, and is well defined.

APRIL 20 TO JULY 6, 1908.

[Indirect method for shifting channels used.]

JULY 7 TO NOVEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.40	395	5.70	570	6.00	770	6.30	1,030
5.50	450	5.80	635	6.10	850	6.40	1,130
5.60	510	5.90	700	6.20	940	6.50	1,230

NOTE—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during July to November, 1908, and is well defined. Above gage height 6.5 feet it is the same as the 1907 table.

Daily discharge, in second-feet, of Duchesne River at Myton, Utah, from April 20 to July 6, 1908.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	815	1,240	2,000	16	.....	935	4,120	.....
2	.....	850	1,180	1,840	17	.....	935	2,100	.....
3	.....	1,020	1,070	1,840	18	.....	980	3,650	.....
4	.....	1,310	980	1,770	19	.....	1,070	2,250	.....
5	.....	1,250	950	1,840	20	1,240	1,280	2,050	.....
6	.....	1,190	950	1,850	21	1,500	1,280	2,500	.....
7	.....	1,130	850	.....	22	1,550	1,220	3,300	.....
8	.....	1,330	845	.....	23	1,480	1,150	3,140	.....
9	.....	1,490	940	.....	24	1,250	1,050	2,970	.....
10	.....	1,420	1,290	.....	25	1,140	1,050	3,200	.....
11	.....	1,300	2,170	.....	26	1,080	1,290	3,120	.....
12	.....	1,180	3,450	.....	27	930	1,450	3,180	.....
13	.....	1,130	4,170	.....	28	880	1,330	2,660	.....
14	.....	1,030	4,480	.....	29	870	1,220	2,250	.....
15	.....	985	4,670	.....	30	780	1,100	2,180	.....
					31	.....	1,140	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Duchesne River at Myton, Utah, for 1905, 1907, and 1908.

[Drainage area, 2,750 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1905.[a]							
March 13–31	355	274	313	0.114	0.08	11,800	A.
April	840	274	448	.163	.18	26,700	A.
May	2,260	643	1,220	.444	.51	75,000	A.
June	5,150	1,300	3,100	1.13	1.26	184,000	A.
July 1–22	2,150	484	902	.328	.27	39,400	A.
September 24–30	920	219	455	.165	.04	6,320	A.
October	484	313	355	.129	.15	21,800	A.
November 1–28	366	313	319	.116	.09	17,700	A.
The period						383,000	
1907.							
April 10–30	2,650	794	2,060	.749	.58	85,800	A.
May	6,000	1,900	3,290	1.20	1.38	202,000	A.
June	7,610	3,400	5,390	1.96	2.19	321,000	A.
July	9,560	2,470	5,680	2.07	2.39	349,000	A.
August	2,440	1,120	1,560	.567	.65	95,900	A.
September	1,400	670	874	.318	.35	52,000	A.
October	792	670	693	.252	.29	42,600	A.
November	670	525	564	.205	.23	33,600	B.
December 1–15	595	525	551	.200	.11	16,400	B.
The period						1,200,000	
1908.							
March 18–31	620	430	490	.178	.09	13,600	A.
April	1,550	430	813	.296	.33	48,400	B.
May	1,490	815	1,160	.422	.49	71,300	B.
June	4,670	845	2,400	.873	.97	143,000	B.
July	2,000	668	1,230	.447	.52	75,600	A.
August	2,440	480	869	.316	.36	53,400	A.
September	850	422	539	.196	.22	32,100	A.
October	770	602	682	.248	.29	41,900	A.
November	668	450	522	.190	.21	31,100	A.
December[b]			527	.192	.22	32,400	D.
The period						543,000	

[a] Omitted from 1905 report. [b] Ice conditions during December, 1908, and discharge estimated.

STRAWBERRY RIVER IN STRAWBERRY VALLEY, UTAH.

This station, which was established May 12, 1903, and discontinued July 12, 1906, was originally located below the junction of Big and Little Strawberry rivers, above the mouth of Indian Creek. It was established below Indian Creek October 14, 1908, but no records of gage heights were obtained in 1908. Measurements are made from a cable whenever possible.

The records show the amount of water available for storage in Strawberry Valley for the use of the Reclamation Service. The water will be stored by a low dam and diverted through a tunnel 18,500 feet long into the drainage basin of Spanish Fork, a tributary of Utah Lake, for irrigation and power development. This tunnel is not yet finished and there are no diversions above the station. The river is frozen over nearly five months of the year.

Discharge measurements of Strawberry River in Strawberry Valley, Utah, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
August 26[a]	E. A. Porter	5.86	25.3
September 23[b]	La Rue and Lytle	5.95	31.3
October 14[c]	do	5.94	29.5

[a] By wading about 100 yards above cable. [b] By wading 10 feet above cable. [c] At cable.

STRAWBERRY RIVER AT THEODORE, UTAH.

This station, which was established June 10, 1908, is located at the west boundary of Theodore town site, along the wagon road to Heber, about 1¼ miles above the junction of the Strawberry with Duchesne River, about one-half mile upstream from the mouth of Indian Canyon, and about 18 miles below the mouth of Currant Creek. Discharge measurements are made by means of a car and cable. The drainage area above the station is nearly 1,200 square miles.

The records are important because they show the run-off of the lower Strawberry and the amount of water available for irrigation.

In connection with the Strawberry Valley project the United States Reclamation Service is building a tunnel 4 miles long, with a capacity of 500 second-feet, to convey water from a 100,000 acre-foot reservoir on Strawberry River across the divide to the Spanish Fork. This tunnel will not be completed for some time to come.

The flow of the stream is affected by ice for about four months during the winter season.

The chain gage is located about 50 feet downstream from the cable from which discharge measurements are made. The datum of the gage has remained constant since the station was established.

Very good results should be obtained at this station except at extremely high stages, when the stream overflows the left bank, rendering it impossible to make gagings.

Discharge measurements of Strawberry River at Theodore, Utah, in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20[a]	R. H. Fletcher	41	251	.....	671
June 11	do	61	136	3.15	389
June 22	do	61	133	3.08	358
July 22	do	61	88	2.38	140
July 31	W. B. Freeman	59	90	2.52	160
August 7	R. H. Fletcher	60	90	2.48	178
August 16	do	60	87	2.40	131
August 26	do	60	76	2.27	98
September 8	do	61	92	2.52	169
September 16	do	60	80	2.32	118
September 28	do	60	78	2.38	135
October 8	do	59	77	2.41	134
October 16	do	60	83	2.39	136
October 27	do	60	80	2.38	136
November 10	do	59	76	2.35	128
November 18	do	56	73	2.25	115
December 9[b]	do	59	53	2.23	81

[a] Measured from bridge. [b] Wading measurement. Ice conditions.

Daily gage height, in feet, of Strawberry River at Theodore, Utah, for 1908.

[M. M. Smith, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.75	3.35	2.25	2.3	2.4	2.4	16	3.4	2.5	2.4	2.3	2.4	2.4	2.65
2	.....	2.7	3.05	2.25	2.3	2.4	2.5	17	3.45	2.5	2.35	2.3	2.4	2.4	2.8
3	.....	2.7	2.55	2.25	2.45	2.4	2.4	18	3.45	2.45	2.35	2.3	2.4	2.4	2.9
4	.....	2.7	2.5	2.25	2.45	2.4	2.65	19	3.3	2.4	2.4	2.3	2.4	2.4	2.8
5	.....	2.6	2.45	2.25	2.4	2.4	2.5	20	3.2	2.4	2.35	2.25	2.4	2.4	2.65
6	.....	2.6	2.55	2.25	2.4	2.4	2.5	21	3.1	2.4	2.35	2.25	2.4	2.4	2.7
7	.....	2.6	2.45	2.2	2.4	2.4	2.5	22	3.1	2.4	2.35	2.25	2.3	2.4	2.75
8	.....	2.6	2.4	2.35	2.4	2.4	2.4	23	3.05	2.4	2.35	2.25	2.35	2.3	3.0
9	.....	2.6	2.4	2.3	2.4	2.4	2.3	24	3.0	2.4	2.3	2.3	2.4	2.3	3.15
10	.....	2.55	2.4	2.3	2.4	2.4	2.75	25	3.0	2.35	2.3	2.6	2.4	2.35	3.2
11	3.2	2.5	2.4	2.45	2.35	2.3	2.55	26	2.9	2.35	2.3	2.5	2.35	2.4	3.2
12	3.3	2.5	2.4	2.45	2.35	2.4	2.6	27	2.9	2.55	2.3	2.4	2.35	2.45	3.2
13	3.3	2.5	2.5	2.4	2.35	2.4	2.6	28	2.85	2.6	2.3	2.35	2.4	2.4	3.2
14	3.3	2.5	2.5	2.35	2.35	2.35	2.55	29	2.8	2.6	2.25	2.4	2.4	2.35	3.25
15	3.3	2.5	2.4	2.35	2.35	2.4	2.7	30	2.8	2.55	2.25	2.35	2.4	2.35	3.3
								31	.....	3.2	2.25	.....	2.4	.....	3.3

NOTE.—Ice conditions during December.

Rating table for Strawberry River at Theodore, Utah, for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	95	2.60	190	3.00	328	3.40	497
2.30	116	2.70	220	3.10	368	3.50	519
2.40	139	2.80	253	3.20	410		
2.50	163	2.90	290	3.30	453		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 16 discharge measurements made during 1908 and is fairly well defined between gage heights 2.25 and 3.20 feet.

Monthly discharge of Strawberry River at Theodore, Utah, for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 11–30	519	253	386	15,300	A.
July	410	128	179	11,000	A.
August	475	106	153	9,410	A.
September	190	95	123	7,320	A.
October	151	116	135	8,300	A.
November	151	116	136	8,090	A.
December	.....	.....	100	6,150	D.
The period	.....	.....	.....	65,600	

NOTE.—Ice conditions during December and discharge estimated.

LAKE FORK BELOW FORKS NEAR WHITEROCKS, UTAH.

This station was established on May 10, 1907, but a fragmentary record was maintained at the same place during 1904. It is located about 500 feet downstream from the junction of the East and West forks, on the old Indian trail from Spanish Fork to Whiterocks, Utah, about 30 miles west of White Rock.

Being above all present diversions, the station furnishes valuable data for determining the run-off and showing the amount of water available for irrigation below and storage above.

No important tributaries enter between this station and the mouth of the stream, and none on either branch for some distance above. The drainage area above the station is about 300 square miles.

The flow of this stream could doubtless be equalized at comparatively small expense by utilizing the storage facilities afforded by a number of the small lakes and reservoir sites found on both branches of the stream above the station. As both of the main tributaries have rapid fall, splendid opportunities for power development are presented above all irrigation diversions.

The winter flow of the stream for several months is affected by most severe ice conditions.

The chain gage established May 10, 1907, has no relation whatever to the 1904 gage. Still another chain gage and datum have been used since September 1, 1907. This gage is located about 100 feet upstream from the cable from which discharge measurements are made.

As the stream bed is rough and the current is swift at high and moderate stages, the results obtained at this station are only fair or approximate except at low stages, when they are fairly good.

Discharge measurements of Lake Fork below forks near Whiterocks, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 21	I. I. Price	70	210	3.05	1,090
June 8	do	75	228	3.32	1,490
June 14	do	75	194	2.98	1,080
July 13	W. G. Garvens	80	294	3.00	2,880
July 25	I. I. Price	80	216	2.48	1,660
August 31	do	75	105	[b] 2.50	560
September 13	do	65	83	2.10	329
September 17	W. B. Freeman	52	93	2.00	280
October 2	R. H. Fletcher	55	89	1.94	264
October 29	do	71	112	1.75	203
November 11	do	62	99	1.55	203
November 25[a]	do	58	94	1.60	193
1908.					
March 23	R. H. Fletcher	52	81	1.35	234
April 3	do	54	66	1.38	196
April 15	do	61	81	1.64	262
April 26	do	62	84	1.72	275
May 12	do	65	112	2.12	500
May 20	do	65	112	2.28	504
June 3	do	60	109	2.19	529
June 20	do	92	190	3.30	1,040
June 28	do	100	230	3.73	1,960
July 8	do	80	147	2.90	901
July 21	do	65	109	2.18	529
July 28	W. B. Freeman	59	106	2.40	457
August 8	R. H. Fletcher	64	109	2.35	476
August 14	do	69	119	2.45	581
August 27	do	58	96	2.05	357
September 8	do	56	85	1.75	318
September 17	do	58	89	1.98	337
September 28	do	58	98	2.05	377
October 7	do	58	95	2.05	361
October 15	do	60	99	2.13	403
October 26	do	58	90	1.93	304
November 9	do	56	84	1.75	287
November 17	do	54	79	1.66	267
December 8	do	53	83	1.55	272
December 21[a]	do	40	97	2.88	248

[a] Ice conditions. [b] Reading from new gage. Old gage read 1.30 feet.

NOTE.—Above measurements made at various sections.

Daily gage height, in feet, of Lake Fork below forks near Whiterocks, Utah, for 1907 and 1908.

[Charles B. Elliott, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1				2.60	4.75	1.85	2.55		1.70	1.60
2				2.70	4.80	1.90	2.50		1.70	1.60
3				2.95	5.00	1.80	2.40		1.70	1.60
4				3.10	5.25	1.90	2.35		1.70	1.60
5				3.25	4.90	1.75	2.50		1.70	1.60
6				3.50	4.60	1.70	2.45		1.65	1.60
7				3.55	4.30	1.65			1.65	1.65
8				3.40	4.00	1.60			1.65	1.70
9				3.45	4.00	1.60			1.65	1.72
10			2.00	3.15	3.00	1.55			1.60	1.68
11			2.00	3.00	3.00	1.45			1.55	1.68
12			2.10	3.00	3.00	1.40			1.55	1.55
13			2.20	3.15	2.95	1.35	2.10		1.50	1.40
14			2.20	3.15	3.00	1.35	2.10		1.50	1.35
15			2.20	3.00	2.85	1.40	2.05		1.45	1.32
16			2.15	2.85	2.70	1.35	2.00		1.50	1.32
17			2.15	2.80	2.50	1.30	2.00		1.55	1.30
18			2.25	2.80	2.50	1.30	2.00		1.60	1.52
19			2.40	3.00	2.50	1.25	1.95		1.60	1.80
20			2.60	3.40	2.72	1.20	1.95		1.60	2.20
21			2.85	3.75	2.75	1.20	1.95		1.55	2.80
22			3.00	4.05	2.48	1.20	1.95		1.40	3.00
23			3.10	3.95	2.35	1.15	1.90		1.40	3.10
24			3.25	3.60	2.35	1.15			1.55	3.05
25			3.15	3.55	2.75	1.30			1.52	3.20
26			3.00	3.65	2.40	1.25			1.55	2.90
27			2.90	3.75	2.25	1.20			1.50	2.40
28			2.75	4.05	2.10	1.20		1.80	1.50	2.10
29			2.70	4.30	2.00	1.20		1.75	1.55	1.90
30			2.60	4.40	2.00	1.30		1.75	1.60	1.90
31			2.55		1.90	1.30		1.68		
1908.										
1				2.4	3.3	3.35	1.85	2.0	1.8	1.6
2				2.3	3.05	2.8	1.85	2.0	1.8	1.5
3		1.38		2.2	3.0	2.6	1.85	2.0	1.8	1.65
4				2.15		2.6	1.8		1.75	1.55
5							1.8		1.8	1.5
6				2.1	3.1		1.8	2.05	1.8	1.5
7				2.1	2.9	2.45	1.75	2.05	1.8	1.45
8				2.15	2.85	2.3	1.9	2.1	1.75	1.45
9				2.35	2.75		2.1	2.1	1.75	1.45
10				2.6	2.7		2.0	2.1	1.75	1.5
11			2.15		2.7	2.3	2.0	2.1	1.7	1.4
12			2.1	4.5	2.65	2.2	2.0	2.15	1.7	1.4
13			2.05	4.65	2.65	2.45	2.05	2.15	1.7	1.4
14			2.00	4.6	2.65	2.5	2.1	2.1	1.7	1.35
15		1.64		4.6	2.7	2.35	2.05	2.1	1.6	1.35
16			1.9	4.1	2.6	2.25	2.0	2.1	1.6	1.3
17			1.9	3.55	2.45	2.15	2.0	2.0	1.6	1.3
18			2.0	3.3	2.35	2.15	1.9	2.1	1.65	1.3
19			2.2	3.2	2.3	2.35	1.9	2.1	1.65	1.35
20			2.25	3.35		2.25	1.9	2.05	1.6	2.5
21			2.2	3.75	2.15	2.2	1.8	2.0	1.6	2.45
22			2.2	4.1	2.1	2.3	1.8	2.0	1.65	3.35
23	1.35		2.15	3.85	2.1	2.4	1.8	2.0	1.6	3.4
24			2.1		2.15	2.3	1.8	2.05	1.65	3.6
25		1.77	2.2		2.05	2.25	2.3	1.95	1.7	3.55
26		1.72	2.5	4.0	2.1		2.1	1.95	1.7	3.4
27			2.45	3.95	2.4	2.05	2.0	1.9	1.7	3.1
28			2.3	3.65	2.4		2.0	1.9	1.7	2.95
29			2.25	3.6	3.05	1.9	2.0	1.9	1.6	2.5
30			2.4	3.4	2.85	1.9	2.0	1.85	1.6	2.4
31			2.5		2.85	1.9		1.85		2.5

NOTE.—A new gage was installed on the opposite bank of the river August 31, 1907, on account of change in channel conditions during the June floods. Readings began on the new gage September 1, 1907.
Ice conditions December 18 to 31, 1907.
Ice conditions during December, 1908.

Rating tables for Lake Fork below forks near Whiterocks, Utah.

1907.

[Daily discharges in 1907 determined by means of an approximate rating and indirect method for shifting channels.]

1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	195	2.20	444	3.10	1,080	4.00	2,220
1.40	214	2.30	493	3.20	1,180	4.10	2,380
1.50	235	2.40	548	3.30	1,285	4.20	2,545
1.60	257	2.50	610	3.40	1,400	4.30	2,715
1.70	281	2.60	675	3.50	1,520	4.40	2,890
1.80	307	2.70	745	3.60	1,650	4.50	3,070
1.90	336	2.80	820	3.70	1,785	4.60	3,255
2.00	367	2.90	900	3.80	1,925	4.70	3,445
2.10	402	3.00	985	3.90	2,070		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and is fairly well defined.

Daily discharge, in second-feet, of Lake Fork below forks near Whiterocks, Utah, for 1907.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	760	7,500	890	610	265	210	190
2	.....	830	7,700	930	560	265	210	190
3	.....	1,040	8,300	860	480	265	210	190
4	.....	1,190	9,300	930	450	265	210	190
5	.....	1,390	8,200	820	560	260	210	190
6	.....	1,810	7,500	790	520	260	200	190
7	.....	1,920	6,600	765	520	260	200	200
8	.....	1,630	5,700	720	450	260	200	210
9	.....	1,720	5,750	720	380	260	200	210
10	450	1,250	2,700	700	380	255	190	210
11	450	1,080	2,750	640	380	255	185	210
12	490	1,080	2,800	610	320	255	185	185
13	540	1,250	2,740	590	320	250	180	160
14	540	1,250	2,880	590	320	250	180	155
15	540	1,080	2,480	610	300	250	170	150
16	520	950	2,110	590	285	240	180	150
17	520	900	1,680	560	285	240	185	150
18	560	900	1,680	560	285	240	190	150
19	640	1,080	1,680	530	270	240	190	150
20	760	1,800	2,160	510	270	240	190	150
21	950	2,800	2,230	510	270	235	185	150
22	1,080	3,880	1,650	510	270	235	160	150
23	1,190	3,740	1,440	490	255	235	160	150
24	1,390	2,840	1,440	490	255	230	185	150
25	1,250	2,830	2,230	560	255	230	180	150
26	1,080	3,240	1,520	530	255	230	185	150
27	990	3,720	1,290	510	255	230	180	150
28	870	4,800	1,120	510	260	230	180	150
29	830	5,760	1,020	510	260	220	185	150
30	760	6,200	1,020	560	260	220	190	150
31	730	.....	930	560	.....	210	.....	150

NOTE.—These discharges were obtained by the indirect method for shifting channels. Daily discharges estimated by comparisons with adjacent stations for days on which there are no gage records. Ice conditions December 18 to 31, 1907; discharge estimated.

Monthly discharge of Lake Fork below forks near Whiterocks, Utah, for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 10–31	1,390	450	779	34,000	B.
June	6,200	760	2,160	129,000	C.
July	9,300	930	3,490	215,000	D.
August	930	490	634	39,000	C.
September	610	255	351	20,900	C.
October	265	210	245	15,100	D.
November	210	160	189	11,200	C.
December	210	.....	169	10,400	D.
The period	.....	.....	.....	475,000	
1908.					
March 15–31	.....	.....	200	6,740	D.
April	.....	.....	237	14,100	D.
May	610	336	422	25,900	C.
June	3,350	402	1,550	92,200	C.
July	1,280	384	721	44,300	C.
August	1,340	336	529	32,500	C.
September	493	294	351	20,900	B.
October	423	322	377	23,200	B.
November	307	257	280	16,700	B.
December	272	228	251	15,400	D.
The period	.....	.....	.....	292,000	

NOTE.—Discharge estimated for periods September 7–12 and September 24 to October 27, 1907. Discharge estimated for period of ice conditions December 18–31, 1907.

Discharge March 15 to May 10, 1908, based on comparative hydrographs for stations in the Uinta River drainage.

Discharge estimated during the frozen period, December, 1908.

LAKE FORK NEAR MYTON, UTAH.

This station, which is located about 3 miles above Myton, Utah, was originally established July 3, 1900, and was known as the station on Lake Fork at mouth. It was discontinued at the end of the season of 1903, although several discharge measurements were made in 1904, and was reestablished June 13, 1907. On October 14, 1907, a cable equipment was installed about one-quarter mile above the gage.

As the station is only about one-half mile above the junction of the stream with Duchesne River, the records show the amount of water which Lake Fork contributes to the Duchesne, and in connection with the records obtained at the station on Lake Fork below the forks, which is about 20 miles upstream and above all present diversions, they indicate also the amount of water diverted for irrigation along the stream. No important tributaries enter between the two stations.

Several canal systems built by the United States Indian Service take water from this stream above the station for irrigation. Some private canal systems are proposed or in operation. As at all other stations in this basin, the stream is icebound for several months during the winter season.

The gage was in the same position and the same datum was used from 1900 to 1904, inclusive. During 1907 and 1908, three distinct gages and datums were used: From June 13 to 30, 1907, from August 18 to December 31, 1907, and during 1908.

The results obtained during 1908 have been very satisfactory, except for a few difficulties in the gage readings. Previous records are not so good.

Discharge measurements of Lake Fork near Myton, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.[a]	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29[b]	I. I. Price	39.6	243	5.45	730
June 13[b]	do	39.6	276	6.30	1,190
June 29[b]	do	39.6	347	8.08	2,380
September 16[c]	Freeman and Price	72	180	2.50	230
September 30[c]	R. H. Fletcher	76	171	2.45	207
October 14[c]	do	66	146	2.40	176
October 31	do	66	141	2.28	185
November 9	do	64	133	2.20	172
November 23	do	64	117	2.12	130
December 10[c]	do	66	148	2.32	179
1908.					
March 24	R. H. Fletcher	64	125	3.48	133
April 6	do	64	115	3.44	117
April 14	do	65	128	3.65	150
April 27	do	65	133	3.78	176
May 13	do	65	159	4.25	261
May 22	do	65	169	4.25	300
June 4	do	65	161	4.25	270
June 20	do	69	318	6.44	1,460
June 28	do	68	286	6.13	1,220
July 8	do	66	210	5.03	609
July 23	do	65	149	4.05	243
July 31	Freeman and Fletcher	66	197	4.83	478
August 6	R. H. Fletcher	66	175	4.45	389
August 17	do	66	160	4.15	265
August 25	do	65	156	4.13	264
September 9	do	65	152	4.10	247
September 15	do	65	141	3.93	207
September 29	do	65	144	3.90	217
October 9	do	65	148	4.00	242
October 17	do	65	158	4.13	306
October 29	do	65	143	3.94	222
November 11	do	65	134	3.72	172
November 18	do	65	138	3.80	188
December 3[d]	do	65	133	3.77	181
December 10[d]	do	65	155	4.10	141

[a] Three gages were used, 1907–8, having no relation to each other. Measurements May 24 to June 29, 1907, refer to gage No. 1. Measurements September 16 to December 10, 1907, refer to gage No 2. Measurements for 1908 refer to gage No. 3.

[b] Measured from bridge

[c] Wading measurement.

[d] Ice conditions.

[e] Wading measurement at cable section.

Daily gage height, in feet, of Lake Fork near Myton, Utah, for 1907 and 1908.

[James McAfee, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1					(b)		2.8	2.3		
2							2.8	2.3		
3							2.7	2.3		
4							2.7	2.3		
5							2.8	2.3		
6							2.8	2.4		
7							2.7	2.5		
8							2.7	2.4		
9							2.6	2.4	2.2	
10							2.6	2.4		2.32
11							2.5	2.4		
12							2.5	2.3		
13				6.3			2.5	2.3		
14				6.2			2.4	2.3		
15				6.0			2.4	2.3		
16				5.7			2.4	2.3		
17				6.0			2.4	2.3		
18				6.0		3.0	2.4	2.3		
19				6.5		3.0	2.4	2.3		
20				7.0		2.9	2.4	2.3		
21				7.5		2.8	2.3	2.3		
22				7.4		2.8	2.3	2.3		
23				7.0		2.8	2.3	2.2	2.12	
24				6.7		2.8	2.3	2.2		
25				6.8		2.8	2.3	2.2		
26				7.0		3.0	2.3	2.3		
27				7.5		2.8	2.3	2.3		
28				8.0		2.7	2.3	2.2		
29			5.45	8.2		2.7	2.3	2.2		
30				8.5		3.0	2.4	2.2		
31						3.0		2.2		
1908.[c]										
1		3.45	3.8	4.4	5.6	5.25	3.9	3.7	3.9	3.6
2		3.45	3.9	4.3	5.55	5.2	3.8	3.8	3.8	3.6
3		3.45	3.9	4.35	5.7	4.7	3.75	3.9	3.8	3.75
4		3.45	4.1	4.3	5.5	4.65	3.65	4.05	3.85	3.6
5		3.45	4.3	4.2	5.35	4.5	3.65	4.2	3.9	3.6
6		3.45	4.3	4.2	5.3	4.5	3.7	4.15	3.9	3.8
7		3.5	4.3	4.25	5.15	4.45	3.8	4.1	3.8	4.0
8		3.55	4.3	4.25	5.05	4.25	4.05	4.05	3.8	4.05
9		3.55	4.5	4.3	4.9	4.1	4.1	4.05	3.7	4.05
10		3.45	4.3	4.85	4.75	4.2	4.0	4.05	3.8	4.05
11		3.5	4.25	6.65	4.75	4.15	4.0	4.05	3.75	4.05
12		3.55	4.3	7.45	4.75	4.35	4.05	4.05	3.7	4.05
13		3.6	4.25	7.75	4.75	4.45	4.05	4.05	3.7	4.05
14		3.7	4.2	7.95	4.7	4.5	4.0	4.0	3.75	3.9
15		3.7	4.25	7.95	4.7	4.35	3.95	3.95	3.8	3.9
16		3.7	4.2	7.35	4.6	4.4	3.9	4.0	3.8	3.9
17		3.8	4.15	6.55	4.5	4.25	3.85	4.2	3.8	3.8
18		3.8	4.15	5.9	4.4	4.15	3.7	4.2	3.7	3.8
19		3.8	4.15	5.6	4.4	4.2	3.65	4.2	3.7	3.75
20		3.9	4.3	5.9	4.2	4.2	3.6	4.2	3.7	3.65
21		3.9	4.3	6.7	4.05	4.25	3.55	4.15	3.7	3.6
22		3.95	4.3	7.05	4.1	4.3	3.45	4.0	3.7	3.6
23		3.95	4.3	6.75	4.4	4.2	3.6	3.9	3.7	3.55
24	3.45	3.95	4.3	7.0	4.05	4.2	3.8	3.9	3.6	3.55
25	3.45	3.85	4.3	6.9	3.95	4.2	4.3	3.85	3.55	3.6
26	3.45	3.85	4.45	6.8	4.0	4.1	4.25	3.85	3.55	3.75
27	3.45	3.85	4.6	6.85	4.1	4.2	4.2	3.9	3.45	3.9
28	3.45	3.8	4.6	6.2	4.25	4.0	3.95	3.9	3.45	3.9
29	3.45	4.0	4.4	6.05	4.55	3.95	3.95	3.9	3.5	3.9
30	3.45	3.85	4.3	6.25	4.9	3.95	3.9	4.0	3.6	4.1
31	3.45		4.3		4.75	3.85		3.95		4.2

[a] Gage heights, August 18 to December 10, 1907, have no relation to gage heights for June, 1907.
[b] Bridge and gage washed out July 1, 1907.
[c] Gage heights, 1908, have no relation to gage heights for 1907. Ice conditions December 6 to 31, 1908.

Rating tables for Lake Fork near Myton, Utah.

JUNE 13 TO 30, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.70	860	6.50	1,310	7.30	1,830	8.10	2,400
5.80	910	6.60	1,370	7.40	1,900	8.20	2,470
5.90	965	6.70	1,430	7.50	1,970	8.30	2,540
6.00	1,020	6.80	1,490	7.60	2,040	8.40	2,615
6.10	1,075	6.90	1,555	7.70	2,110	8.50	2,690
6.20	1,130	7.00	1,620	7.80	2,180		
6.30	1,190	7.10	1,690	7.90	2,255		
6.40	1,250	7.20	1,760	8.00	2,330		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on 3 discharge measurements made during May and June, 1907, and is only fairly defined.

AUGUST 18, 1907, TO DECEMBER 9, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	125	2.40	200	2.70	295	3.00	405
2.20	150	2.50	230	2.80	330		
2.30	175	2.60	260	2.90	365		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 7 discharge measurements made during September to November, 1907, and is not well defined.

1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	115	4.50	373	5.60	892	6.70	1,635
3.50	132	4.60	407	5.70	951	6.80	1,715
3.60	150	4.70	445	5.80	1,012	6.90	1,795
3.70	169	4.80	485	5.90	1,075	7.00	1,875
3.80	190	4.90	527	6.00	1,140	7.20	2,045
3.90	212	5.00	572	6.10	1,205	7.40	2,215
4.00	235	5.10	620	6.20	1,275	7.60	2,390
4.10	258	5.20	671	6.30	1,345	7.80	2,570
4.20	283	5.30	724	6.40	1,415	8.00	2,750
4.30	310	5.40	778	6.50	1,485		
4.40	340	5.50	834	6.60	1,560		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 24 discharge measurements made during 1908, and is well defined.

Monthly discharge of Lake Fork near Myton, Utah, for 1907 and 1908.

[Drainage area, 475 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
June 13–30	2,690	860	1,590	3.35	2.24	56,800	C.
August 18–31	405	295	354	.745	.39	9,830	C.
September	330	175	230	.484	.54	13,700	B.
October	230	150	176	.371	.43	10,800	B.
November	150	130	142	.299	.33	8,450	D.
December 1–9	180	150	163	.343	.12	2,910	D.
The period						102,000	
1908.							
March 24–31	124	124	124	.261	.08	1,970	A.
April	235	124	170	.358	.40	10,100	A.
May	407	190	302	.636	.73	18,600	A.
June	2,700	283	1,260	2.65	2.96	75,000	A.
July	951	224	476	1.00	1.15	29,300	A.
August	698	201	328	.691	.80	20,200	A.
September	301	124	208	.438	.49	12,400	A.
October	283	169	237	.499	.58	14,600	A.
November	212	124	173	.364	.41	10,300	A.
December	180	135	147	.309	.36	9,040	D.
The period						202,000	

NOTE.—Discharge estimated for November and December, 1907. Discharge estimated for the frozen period, December 6–31, 1908.

UINTA RIVER NEAR WHITEROCKS, UTAH.

This station was originally established in connection with the investigation for the water supply of the Uinta Reservation, on September 16, 1899, and the records were continued until the latter part of 1904. It was reestablished in the same locality on August 13, 1907.

The present station is located at the highway bridge on the government road up Uinta Canyon, usually known as the saw mill road. The bridge is about 10 miles northwest of the Indian agency at Whiterocks. Previous records were taken at points a short distance upstream from this bridge.

The data obtained show the amount of water available for storage and power development above and for irrigation below.

The station is situated about a mile below the mouth of Pole Creek. The Whiterocks comes in several miles below, but there are no other tributaries of any importance except some dry gulches which occasionally carry considerable flood water.

No water is diverted from the stream above the station, but the United States Indian Service has constructed a series of irrigation canals, which divert water at various points below. The upper reaches of this stream present excellent opportunities for storage and power development.

The results at the station are affected by ice during the winter season. Winter measurements are usually taken at riffles or open places in the channel.

The same gage was used from 1899 to 1904, inclusive. The gage established in August, 1907, was located a short distance upstream from the old gage, and at a different datum. The present chain gage has no determined relation to this last gage. It was established on October 22, 1907, and is located on the bridge about a mile downstream from the other gage.

As no one lives in the vicinity of the gage, it is read only when the hydrographer visits the station to take discharge measurements, and the discharge for intermediate days is estimated by comparison with the hydrographs of other streams in that locality.

As the stream bed is rough and the current swift at high and moderate stages, the discharge measurements, except at low stages, are apt to be considerably in error. The method of computing daily and monthly discharges makes them necessarily only rather approximate.

Discharge measurements of Uinta River near Whiterocks, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 13	I. I. Price	83	113	1.10	456
August 25	do	84.5	101	1.05	379
September 10	do	84.5	90	.90	301
October 9	R. H. Fletcher	68	86	.78	286
October 22	do	70	80	1.30	219
November 5	do	69	73	1.22	206
November 19	do	68	64	1.10	155
1908.					
March 30[a]	R. H. Fletcher	63	61	.98	123
April 10[a]	do	65	64	1.05	146
April 18	do	69	72	1.18	202
April 25	do	71	85	1.40	221
May 11	do	73	96	1.52	315
May 19	do	75	129	1.88	516
June 3	do	73	104	1.63	348
June 18	do	78	161	2.20	1,010
June 27	do	80	163	2.35	1,240
July 7	do	75	134	2.00	706
July 21	do	72	112	1.70	543
July 27	Freeman and Fletcher	72	125	1.90	544
August 13	R. H. Fletcher	75	115	1.82	468
August 22	do	75	122	1.85	479
August 28	do	73	105	1.60	329
September 3	do	71	98	1.45	298
September 18	do	71	94	1.48	316
September 25	do	75	117	1.85	448
October 5	do	72	101	1.50	333
October 13	do	72	97	1.50	323
October 23	do	71	95	1.45	294
November 7	do	70	81	1.30	241
November 14	do	70	83	1.28	240
November 24	do	70	77	1.20	213
December 7[b]	do	70	76	1.22	155
December 24[b]	do	81	206	3.10	237

[a] Some ice. [b] Ice conditions.

NOTE.—On October 9, 1907, station was moved 1 mile down stream to a bridge. New gage established at bridge on October 22, 1907.

Monthly discharge of Uinta River near Whiterocks, Utah, for 1907 and 1908.

[Drainage area, 218 square miles.]

Month.	Discharge in second-feet.		Run-off.	
	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1907.				
August 13–31	373	1.71	1.21	14,100
September	308	1.41	1.57	18,300
October	250	1.15	1.33	15,400
November	174	.798	.89	10,400
The period				58,200
1908.				
March 15–31	146	.670	.42	4,920
April	172	.789	.88	10,200
May	358	1.60	1.84	21,400
June	910	4.17	4.65	54,100
July	636	2.92	3.37	39,100
August	444	2.04	2.35	27,300
September	327	1.50	1.67	19,500
October	325	1.49	1.72	20,000
November	236	1.08	1.20	14,000
December	202	.927	1.07	12,400
The period				223,000

NOTE.—The above values are classed as C. The daily discharges were obtained from a hydrograph passing through the measurements and following the rates of rise and fall of other stream in the basin on which daily records were obtained.

UINTA RIVER AT FORT DUCHESNE, UTAH.

This station, which is located at the wooden highway bridge on the road to Vernal, one-fourth of a mile from Fort Duchesne, Utah, was originally established on September 4, 1899, and continued until the end of 1904. It was also maintained for a brief period during 1906, and on April 9, 1907, the station was reestablished.

The data obtained at this point show the amount of water contributed by this stream to Duchesne River, except the comparative small amount diverted for irrigation below, and in connection with the records of the stations above on the Whiterocks and the Uinta, they show the amount of water taken for irrigation by the numerous diversions both on the Uinta and Whiterocks above the station. The upper tributaries, above irrigation diversions, afford excellent opportunities for storage and power development.

The flow of the stream is affected by ice for about four months during the winter season, and the accuracy of the results is somewhat affected by eddies around the crib piers and by deposits of sediment brought down by Deep Creek during floods.

Practically the same datum was used for the gage up to and including 1906. The present chain gage, established April 9, 1907, has an entirely different datum. It is fastened to the bridge from which discharge measurements are made.

Discharge measurements of Uinta River at Fort Duchesne, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	Meeker and Price	81	297	6.44	181
April 24	I. I. Price	81	322	6.72	335
May 13	do	81	310	6.80	345
May 28	do	81	384	7.30	857
June 11	do	81	412	7.65	1,350
June 28	do	81	477	8.52	2,800
July 10	J. B. Cabanis	81	466	7.95	2,050
August 14	I. I. Price	81	367	6.76	408
September 3	do	81	340	6.62	305
September 19	R. H. Fletcher	79	329	6.43	218
October 10	do	79	333	6.42	202
October 23	do	80	322	6.35	173
November 6	do	80	281	6.34	150
November 20	do	80	254	6.35	142
December 5[a]	do	80	245	6.50	99
1908.					
March 26	R. H. Fletcher	80	227	6.32	139
April 1	do	78	217	6.28	108
April 11	do	80	219	6.37	137
April 23	do	80	239	6.60	244
May 2	do	80	230	6.50	189
May 16	do	80	250	6.56	223
June 5	do	80	261	6.58	214
June 15	do	80	478	8.30	2,360
June 25	do	80	417	7.48	872
July 9	do	80	372	6.83	317
July 25[b]	Freeman and Fletcher	68	66	6.40	106
August 11	R. H. Fletcher	80	348	6.61	228
August 18	do	80	351	6.65	244
August 24	do	80	369	6.85	339
August 31[b]	do	78	94	6.55	226
September 10[b]	do	80	94	6.62	246
September 21	do	70	73	6.42	139
September 30	do	80	344	6.78	302
October 10	do	80	348	6.76	295
October 19	do	80	350	6.82	338
October 30	do	80	343	6.75	293
November 5	do	80	339	6.70	262
November 13	do	80	326	6.62	236
November 23	do	77	77	6.51	197
December 2[a b]	do	75	85	6.78	226
December 17[a b]	do	56	77	6.95	177

[a] Ice conditions. [b] Wading measurement.

Daily gage height, in feet, of Uinta River at Fort Duchesne, Utah, for 1907 and 1908.

[Lucile Pierce, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1	.....	.....	6.68	7.25	8.62	7.15	6.65	6.40	6.35	6.45
2	.....	.....	6.65	7.68	8.65	7.25	6.65	6.40	6.35	6.50
3	.....	.....	6.65	7.78	8.65	7.22	6.65	6.42	6.32	6.52
4	.....	.....	6.60	7.95	8.65	7.20	6.62	6.40	6.32	6.45
5	.....	.....	6.65	8.18	8.65	7.15	6.65	6.40	6.32	6.40
6	.....	.....	6.65	8.25	8.42	7.08	6.70	6.40	6.32	6.45
7	.....	.....	6.55	8.02	8.25	7.02	6.70	6.50	6.32	6.40
8	.....	.....	6.55	8.00	8.15	7.00	6.65	6.48	6.35	6.32
9	.....	6.42	6.48	7.60	8.10	6.98	6.55	6.40	6.32	6.32
10	.....	6.48	6.45	7.65	7.95	6.90	6.55	6.40	6.32	6.42
11	.....	6.62	6.52	7.62	7.85	6.90	6.55	6.40	6.32	6.45
12	.....	6.75	6.72	7.82	7.78	6.90	6.55	6.40	6.30	6.45
13	.....	6.80	6.80	7.72	7.75	6.85	6.52	6.40	6.30	6.45
14	.....	6.92	6.72	7.60	7.72	6.80	6.50	6.40	6.30	6.35
15	.....	7.00	6.68	7.50	7.65	6.82	6.50	6.40	6.35	6.25
16	.....	7.00	6.60	7.42	7.45	6.68	6.52	6.40	6.35	.....
17	.....	6.92	6.75	7.45	7.40	6.60	6.45	6.40	6.28	.....
18	.....	6.90	6.88	7.65	7.40	6.60	6.45	6.40	6.32	.....
19	.....	6.85	7.12	8.10	7.32	6.60	6.45	6.40	6.32	.....
20	.....	6.80	7.40	8.28	7.32	6.60	6.45	6.40	6.32	.....
21	.....	6.75	7.60	8.40	7.65	6.70	6.45	6.35	6.35	.....
22	.....	6.78	7.80	8.32	7.45	6.55	6.45	6.35	6.30	.....
23	.....	6.72	7.98	8.00	7.38	6.50	6.40	6.35	6.35	.....
24	.....	6.70	7.88	7.95	7.40	6.50	6.40	6.40	6.42	.....
25	.....	6.70	7.72	8.15	7.65	6.62	6.40	6.40	6.45	.....
26	.....	6.75	7.50	8.15	7.50	6.68	6.40	6.40	6.48	.....
27	.....	6.75	7.38	8.35	7.52	6.60	6.40	6.35	6.50	.....
28	.....	6.75	7.30	8.50	7.42	6.60	6.40	6.35	6.52	.....
29	.....	6.80	7.20	8.48	7.35	6.60	6.40	6.35	6.40	.....
30	.....	6.72	7.18	8.58	7.30	6.70	6.40	6.35	6.42	.....
31	.....	.....	7.15	.....	7.22	6.80	.....	6.35	.....	.....
1908.[b]										
1	.....	6.25	6.4	6.85	7.0	6.7	6.45	6.7	6.7	6.7
2	.....	6.25	6.5	6.7	7.0	6.7	6.45	6.65	6.7	6.7
3	.....	6.3	6.7	6.65	6.95	6.65	6.45	6.75	6.7	6.8
4	.....	6.3	6.8	6.6	6.95	6.55	6.4	6.75	6.6	6.8
5	.....	6.3	6.7	6.6	7.0	6.45	6.4	6.75	6.6	6.8
6	.....	6.3	6.65	6.6	6.9	6.5	6.4	6.7	6.7	6.7
7	.....	6.4	6.7	6.85	6.95	6.5	6.35	6.8	6.65	6.65
8	.....	6.35	6.8	6.85	6.85	6.4	6.3	6.7	6.65	6.75
9	.....	6.35	6.85	6.9	6.85	6.35	6.85	6.75	6.65	6.75
10	.....	6.3	6.8	7.55	6.85	6.4	6.6	6.8	6.65	6.75
11	.....	6.35	6.7	7.95	6.85	6.6	6.6	6.8	6.65	6.8
12	.....	6.35	6.7	8.3	6.8	6.6	6.55	6.75	6.65	6.8
13	.....	6.4	6.7	8.2	6.8	6.5	6.55	6.75	6.6	6.9
14	6.45	6.4	6.6	8.2	6.75	6.85	6.6	6.7	6.6	6.7
15	6.45	6.4	6.5	8.15	6.75	6.8	6.6	6.7	6.6	6.9
16	6.45	6.35	6.55	7.8	6.7	6.65	6.5	6.85	6.6	7.0
17	6.45	6.4	6.6	7.6	6.5	6.65	6.5	6.85	6.55	6.9
18	6.45	6.4	6.7	7.4	6.5	6.6	6.5	6.85	6.6	6.85
19	6.35	6.4	7.0	7.25	6.5	6.8	6.45	6.8	6.6	6.3
20	6.3	6.5	7.1	7.25	6.4	6.85	6.5	6.85	6.6	6.8
21	6.3	6.5	6.9	7.35	6.4	6.7	6.4	6.8	6.6	6.8
22	6.3	6.5	6.8	7.45	6.35	6.85	6.4	6.8	6.55	6.8
23	6.3	6.55	6.75	7.35	6.35	6.9	6.4	6.7	6.5	7.1
24	6.3	6.55	6.7	7.3	6.4	6.9	6.6	6.7	6.55	7.2
25	6.3	6.45	6.7	7.4	6.4	6.8	7.1	6.7	6.5	7.2
26	6.3	6.45	6.85	7.35	6.4	6.7	6.85	6.7	6.5	7.25
27	6.3	6.45	6.9	7.45	6.4	6.6	6.7	6.7	6.5	7.4
28	6.3	6.4	6.8	7.2	6.5	6.6	6.7	6.7	6.5	7.4
29	6.3	6.4	6.7	7.1	6.6	6.6	6.7	6.75	6.65	7.4
30	6.3	6.4	6.8	7.05	6.7	6.55	6.7	6.7	6.6	7.4
31	6.25	.....	7.0	.....	6.55	6.5	.....	6.7	.....	7.4

[a] Ice conditions November 24 to December 31, 1907.
[b] Ice conditions during December, 1908.

Rating tables for Uinta River at Fort Duchesne, Utah.

APRIL 9 TO JUNE 30, 1907, AND NOVEMBER 1 TO 23, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.30	135	6.90	450	7.50	1,125	8.10	2,075
6.40	160	7.00	535	7.60	1,270	8.20	2,260
6.50	200	7.10	635	7.70	1,420	8.30	2,455
6.60	250	7.20	750	7.80	1,575	8.40	2,660
6.70	310	7.30	870	7.90	1,735	8.50	2,870
6.80	375	7.40	995	8.00	1,900	8.60	3,080

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 8 discharge measurements made during above periods and is well defined.

JULY 1 TO OCTOBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.30	150	7.00	640	7.60	1,485	8.20	2,525
6.40	190	7.10	750	7.70	1,650	8.30	2,730
6.50	240	7.20	875	7.80	1,815	8.40	2,945
6.60	300	7.30	1,015	7.90	1,980	8.50	3,170
6.70	370	7.40	1,165	8.00	2,150	8.60	3,395
6.80	450	7.50	1,325	8.10	2,330	8.70	3,620
6.90	540						

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on 5 discharge measurements made during above period and form of previous curves and is well defined.

MARCH 14 TO MAY 31, AUGUST 28 TO SEPTEMBER 15, AND NOVEMBER 19 TO 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.20	88	6.50	194	6.80	375	7.00	535
6.30	118	6.60	246	6.90	450	7.10	635
6.40	153	6.70	306				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during the above periods and is fairly well defined.

JUNE 1 TO 16, AUGUST 3 TO 27, AND SEPTEMBER 16 TO NOVEMBER 18, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.30	101	6.90	392	7.40	895	7.90	1,620
6.40	133	7.00	472	7.50	1,020	8.00	1,795
6.50	170	7.10	563	7.60	1,155	8.10	1,975
6.60	213	7.20	665	7.70	1,300	8.20	2,165
6.70	264	7.30	775	7.80	1,455	8.30	2,360
6.80	323						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during the above periods and is fairly well defined.

JUNE 17 TO AUGUST 2, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.30	76	6.70	238	7.10	515	7.40	795
6.40	106	6.80	295	7.20	600	7.50	900
6.50	143	6.90	360	7.30	695	7.60	1,010
6.60	187	7.00	435				

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made during the above period and is fairly well defined.

Monthly discharge of Uinta River at Fort Duchesne, Utah, for 1907 and 1908.

[Drainage area, 672 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 9–30	535	168	361	0.537	0.44	15,800	A.
May	1,870	180	635	.945	1.09	39,000	A.
June	3,040	810	1,860	2.77	3.09	111,000	A.
July	3,510	903	1,860	2.77	3.19	114,000	A.
August	945	240	487	.725	.84	29,900	A.
September	370	190	253	.376	.42	15,100	A.
October	240	170	188	.280	.32	11,600	A.
November	148	120	139	.207	.23	8,270	B.
December 1–15			102	.152	.08	3,030	D.
The period						348,000	
1908.							
March 14–31	174	103	134	.199	.13	4,940	B.
April	220	103	152	.226	.25	9,040	B.
May	635	153	342	.509	.59	21,000	A.
June	2,360	213	857	1.28	1.43	51,000	B.
July	435	91	242	.360	.42	14,900	B.
August	392	117	243	.362	.42	14,900	B.
September	563	118	216	.321	.36	12,800	B.
October	358	238	292	.436	.50	18,000	A.
November	276	192	228	.339	.38	13,600	B.
December			191	.284	.33	11,700	D.
The period						172,000	

NOTE.—Probable ice conditions November 24 to December 15, 1907, discharge estimated. Ice conditions during December, 1908, discharge estimated.

WHITEROCKS RIVER NEAR WHITEROCKS, UTAH.

This station, which is located at the mouth of the canyon at the foot of "Dugway" on the road from the plateau to the river bottom, about 10 miles above the Indian Agency at Whiterocks, was established April 18, 1899, and continued until the end of 1904. On April 11, 1907, it was reestablished at practically the same place. (See Pl. V, *B*.) Discharge measurements are made by means of a car and cable.

The information contained here is valuable in connection with general studies of run-off problems and to show the amount of water available for storage and power above and for irrigation below.

The station is below all important tributaries of the Whiterocks. The first diversion for irrigation is about 3 miles below the station. Excellent storage possibilities and opportunities for power development exist above all irrigation diversions.

Like other streams in this region, the river is icebound for several months in the winter.

The same gage and datum were used from the establishment of the station until the end of 1904. A new chain gage and datum were used from April 11, 1907, to May 8, 1908, and the present chain gage, at a still different datum, has been used since May 9, 1908.

Measurements are made from a cable about 100 feet downstream from the gage.

Owing to the remoteness of this gage from any dwelling, daily gage observations have not been made, and daily and monthly discharges have been obtained by comparing the relatively frequent discharge measurements with the hydrographs of other streams in that section.

As the stream bed is rather rough and the current is swift, measurements at high or medium stages are not very accurate. The daily and monthly discharge estimates, computed by the method outlined above, are necessarily only approximate.

Discharge measurements of Whiterocks River near Whiterocks, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 11[a]	I. I. Price	38	51	2.90	134
April 27	do	38	58	3.00	146
May 11	do	39	54	3.00	145
May 26	do	50	88	4.10	454
June 3	do	55	108	4.62	702
June 10	do	54	94	4.30	516
June 25	do	58	134	5.32	1,030
July 2	do	75	174	5.60	1,320
July 9	J. B. Cabanis	55	131	4.75	936
July 16	do	55	93	4.10	479
July 23	I. I. Price	50	77	4.00	388
August 2	do	50	70	3.95	349
August 12	do	35	44	3.45	185
August 24	do	35	42	3.25	161
September 5	do	30	42	[b]3.40	144
September 18	Freeman and Fletcher	31	34	2.94	110
October 7	R. H. Fletcher	31	34	3.00	98
October 21	do	32	31	2.70	91
November 4	do	32	34	2.62	77
November 18	do	31	34	2.68	89
December 3[c]	do	31	32	2.55	80
1908.					
March 28[a]	R. H. Fletcher	28	27	2.66	58
April 9	do	30	28	2.65	61
April 17	do	30	35	2.70	88
April 24	do	31	40	3.02	128
May 9	do	40	60	[d]1.87	246
May 18	do	45	75	2.05	348
June 2	do	35	56	1.80	242
June 17	do	55	100	2.68	630
June 26	do	50	88	2.35	506
July 6	do	35	54	1.87	246
July 20	do	31	45	1.60	202
July 26[a]	Freeman and Fletcher	30	49	1.56	142
August 12	R. H. Fletcher	31	48	1.62	173
August 22	do	35	59	1.90	244
August 29	do	31	49	1.60	168
September 4	do	30	39	1.48	120
September 18	do	30	45	1.48	140
September 26	do	35	54	1.80	184
October 6	do	31	49	1.64	157
October 14	do	31	47	1.60	148
October 24	do	31	46	1.58	139
November 8	do	30	40	1.34	95
November 16[c]	do	30	40	1.48	88
November 28[c]	do	30	44	1.80	68
December 6[c]	do	30	37	1.32	94
December 19[c]	do	55	99	3.48	54

[a] Wading measurement.
[b] Backwater caused by fallen tree in stream below gage.
[c] Ice conditions.
[d] New gage. Old gage was washed out about May 4, 1908, and new gage was established May 10, 1908. The gage datum and locations are not the same.

Monthly discharge of Whiterocks River near Whiterocks, Utah, for 1907 and 1908.

[Drainage area, 114 square miles.]

Month.	Discharge in second-feet.		Run-off.	
	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1907.				
April 11–30	204	1.79	1.33	8,090
May	274	2.40	2.77	16,800
June	800	7.02	7.83	47,600
July	735	6.45	7.44	45,200
August	203	1.78	2.05	12,500
September	127	1.11	1.24	7,560
October	91.6	.804	.93	5,630
November	84.0	.737	.82	5,000
December 1–15	80.0	.702	.39	2,380
The period				151,000
1908.				
March 15–31	77.8	.682	.36	2,620
April	79.2	.695	.78	4,710
May	220	1.93	2.22	13,500
June	524	4.60	5.13	31,200
July	208	1.82	2.10	12,800
August	198	1.74	2.01	12,200
September	156	1.37	1.53	9,280
October	187	1.64	1.89	11,500
November	95.8	.840	.94	5,700
December	72.6	.637	.73	4,460
The period				108,000

NOTE.—The above values are classed as C.
The daily discharges were obtained from a hydrograph passing through the measurements following the rate of rise and fall of the other stream in the basin on which daily records were obtained.

PRICE RIVER NEAR HELPER, UTAH.

Price River rises in the Wasatch Mountains, in the southeastern part of Utah County, flows in a generally southeasterly direction and unites with Green River at a point about 14 miles above Greenriver, Utah. The main source of supply is the snow in the upper reaches of the basin, where elevations range from 8,000 to 9,000 feet. The region is extremely rough and rugged. The predominant rock is a loose and badly disintegrated sandstone. The soil is scanty and supports practically no vegetation except small groves of scrubby cedar and a few scattered pines. The original sparse underbrush and grass have been almost entirely tramped out by sheep and cattle.

The river is subject to floods in the spring and early summer, during which time it carries immense quantities of sediment. Gordon and Pleasant creeks, the principal tributaries, are both short, steep streams and enter from the west almost at right angles.

This gaging station, which was established February 21, 1904, is located on the upper side of the ford, about 3 miles south of Helper, Utah, and 350 feet west of the main line of the Denver and Rio Grande Railroad.

The datum of the original chain gage remained unchanged until washed out by high water April 11, 1907. It was replaced by a temporary gage June 23, 1907, and by a permanent gage July 16, 1907. All gage heights after June 22, 1907, are referred to a new datum 0.7 foot above the original datum. The bed of the stream is composed of fine gravel and sand and shifts slightly, especially during high water, and new rating curves are required each year. The records of discharge are considered fairly good.

Discharge measurements of Price River near Helper, Utah, in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 22	La Rue and Burridge	62	203	4.60	714
July 15	G. T. Burridge	60	143	3.45	224
August 2	do	52	115	3.30	137
August 27	do	47	96	3.15	100
1908.					
March 25	A. D. Williams	42	71	2.95	79.3
July 10	Hoyt and La Rue	40	82	2.78	48.0

Daily gage height, in feet, of Price River near Helper, Utah, for 1907 and 1908.

[John Tyron and Mrs. Rozina Farnsworth, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	3.3	3.3	3.5	3.9			4.1	3.3	3.2	2.9	2.9	2.8
2	3.3	3.3	3.5	4.0			4.0	3.3	3.1	2.9	2.9	2.8
3	3.3	3.3	3.5	4.0			4.0	3.6	3.1	2.9	2.9	2.8
4	3.3	3.5	3.6	4.1			3.9	3.3	3.1	2.9	2.9	2.8
5	3.3	3.5	3.6	4.2			3.9	3.3	3.1	2.9	2.9	2.8
6	3.3	3.5	3.6	4.2			3.8	3.3	3.2	2.9	2.9	2.8
7	3.3	3.5	3.6	4.2			3.8	3.3	3.1	2.9	2.9	2.8
8	3.3	3.3	3.6	4.4			3.8	3.2	3.1	2.9	2.9	2.8
9	3.3	3.3	3.6	4.4			3.7	3.2	3.1	2.9	2.9	2.8
10	3.3	3.6	3.6	4.5			3.6	3.2	3.1	2.9	2.9	2.8
11	3.3	3.6	3.6	4.7			3.6	3.1	2.9	2.9	2.8	2.8
12	3.3	3.5	3.4				3.5	3.1	2.9	2.9	2.8	2.8
13	3.3	3.5	3.4				3.6	3.1	2.9	2.9	2.8	2.8
14	3.3	3.5	3.3				3.5	3.1	2.9	2.9	2.8	2.8
15	3.3	3.5	3.3				3.4	3.1	2.9	2.9	2.8	2.8
16	3.3	3.5	3.3				3.5	3.1	2.9	2.9	2.8	2.8
17	3.3	3.5	3.3				3.5	3.1	2.9	2.9	2.8	2.8
18	3.3	3.5	3.3				3.5	3.1	2.9	2.9	2.8	2.8
19	3.3	3.5	3.4				3.5	3.1	2.9	2.9	2.8	2.8
20	3.3	3.5	3.7				3.5	3.1	2.9	2.9	2.8	2.8
21	3.3	3.5	4.0				3.4	3.0	2.9	2.9	2.8	2.8
22	3.3	3.5	4.0				3.4	2.9	2.9	2.9	2.8	2.9
23	3.3	3.4	4.0			4.6	3.4	3.0	2.9	2.9	2.8	2.9
24	3.3	3.6	4.0			4.3	3.4	3.1	2.9	2.9	2.8	2.9
25	3.3	3.5	3.9			4.3	3.4	4.5	2.9	2.9	2.8	2.9
26	3.3	3.5	3.9			4.3	3.4	3.5	2.9	2.9	2.8	2.9
27	3.6	3.5	3.9			4.2	3.4	3.4	2.9	2.9	2.8	2.9
28	3.6	3.5	3.9			4.2	3.5	3.4	2.9	2.9	2.8	2.8
29	3.6		3.8			4.1	3.4	3.1	2.9	2.9	2.8	2.8
30	3.6		3.7			4.1	3.4	3.6	2.9	2.9	2.8	2.8
31	3.4		3.8				3.3	3.5		2.9		2.8

[a] Gage washed out April 11, 1907, and new gage installed at different datum from previous gage June 23, 1907.

Daily gage height, in feet, of Price River near Helper, Utah, for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	2.8	2.7	2.7	2.9	3.7	3.5	2.9	2.9	2.8	2.7	2.8	2.7
2	2.8	2.7	2.7	2.8	3.5	3.5	2.9	2.9	2.5	2.7	2.8	2.7
3	2.8	2.7	2.7	2.8	3.6	3.4	2.9	2.8	2.5	2.7	2.8	2.7
4	2.8	2.7	2.7	2.95	3.4	3.4	2.9	2.8	2.5	2.8	2.8	2.7
5	2.8	2.7	2.7	3.0	3.4	3.4	2.8	2.8	2.4	2.9	2.8	2.7
6	2.8	2.7	2.7	3.0	3.4	3.4	2.7	2.8	2.4	2.8	2.7	2.7
7	2.8	2.7	2.7	3.9	3.4	3.4	2.7	2.7	2.4	2.8	2.7	2.7
8	2.8	2.7	2.7	3.0	3.5	3.4	2.7	2.7	2.4	2.7	2.7	2.7
9	2.8	2.7	2.7	3.0	3.5	3.4	2.8	2.7	2.4	2.7	2.7	2.7
10	2.8	2.7	2.7	3.0	3.5	3.5	2.8	2.7	2.4	2.7	2.7	2.65
11	2.7	2.7	2.7	3.9	3.5	3.5	2.7	2.7	2.4	2.7	2.7	2.6
12	2.7	2.7	2.7	3.8	3.6	3.4	2.7	2.8	2.4	2.7	2.6	2.6
13	2.7	2.8	2.7	3.9	3.5	3.4	2.7	4.2	2.4	2.7	2.6	2.7
14	2.7	2.9	2.7	3.8	3.5	3.4	2.7	3.1	2.4	2.7	2.6	2.7
15	2.7	2.9	4.8	3.7	3.5	3.4	2.7	2.7	2.4	2.6	2.7	2.7
16	2.7	2.8	4.8	3.7	3.5	3.4	2.7	2.7	2.8	2.6	2.7	2.7
17	2.7	2.7	4.5	3.8	3.6	3.4	2.7	2.8	2.4	2.7	2.7	2.7
18	2.7	2.7	3.0	3.8	3.7	3.4	2.6	2.8	2.8	2.6	2.8	2.7
19	2.7	2.7	3.0	3.8	3.6	3.2	2.6	2.8	2.4	2.6	2.8	2.7
20	2.7	2.7	3.9	3.6	3.6	3.2	2.6	2.7	2.4	2.6	2.8	2.7
21	2.7	2.8	3.8	3.7	3.5	3.1	2.6	2.7	2.5	2.6	2.7	2.6
22	2.7	2.8	3.9	3.6	3.5	3.0	2.6	2.7	2.4	2.6	2.7	2.6
23	2.7	2.8	3.9	3.6	3.5	3.1	2.6	2.7	2.4	2.6	2.7	2.6
24	2.7	2.8	3.9	3.6	3.5	3.1	2.6	2.7	2.4	2.6	2.7	2.6
25	2.7	2.8	3.0	3.8	3.6	3.0	2.6	2.7	2.4	2.6	2.7	2.6
26	2.7	2.7	4.2	3.8	3.7	3.0	2.6	2.6	2.7	2.7	2.7	2.6
27	2.8	2.7	3.0	3.7	3.7	3.0	3.0	2.5	2.8	2.7	2.7	2.6
28	2.7	2.7	3.9	3.8	3.5	3.0	2.75	2.5	2.8	2.7	2.7	2.6
29	2.7	2.7	3.9	3.8	3.5	3.0	3.5	2.5	2.6	2.7	2.7	2.6
30	2.7	.....	3.9	3.7	3.5	3.0	3.1	2.5	2.7	2.7	2.7	2.5
31	2.7	.....	3.9	.....	3.5	.....	3.1	2.4	.....	2.7	.....	2.5

[a] Slight ice conditions during January, February, and December, 1908.

Rating tables for Price River near Helper, Utah.

JANUARY 1, 1905, TO APRIL 11, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	18	3.70	78	4.10	182	4.50	354
3.40	30	3.80	98	4.20	219	4.60	404
3.50	44	3.90	122	4.30	260	4.70	455
3.60	60	4.00	150	4.40	305		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1906. It is well defined.

JUNE 23 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	42	3.30	140	3.80	324	4.30	572
2.90	54	3.40	170	3.90	370	4.40	626
3.00	70	3.50	204	4.00	418	4.50	680
3.10	90	3.60	242	4.10	468	4.60	736
3.20	114	3.70	282	4.20	520		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 3 discharge measurements made during 1907 and the form of the average rating curve for this station. It is fairly well defined.

Rating tables for Price River near Helper, Utah—Continued.

1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	7	3.10	113	3.80	371	4.50	735
2.50	14	3.20	140	3.90	418	4.60	790
2.60	23	3.30	170	4.00	467	4.70	850
2.70	35	3.40	204	4.10	518	4.80	910
2.80	50	3.50	242	4.20	570		
2.90	68	3.60	283	4.30	625		
3.00	89	3.70	326	4.40	680		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 2 discharge measurements made during 1908 and the form of earlier curves, and is fairly well defined.

Monthly discharge of Price River near Helper, Utah, for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	60	18	23.8	1,460	D.
February	60	18	40.6	2,250	C.
March	150	18	72.0	4,430	C.
April 1–11	455	122	244	5,320	B.
June 23–30	736	468	554	8,790	B.
July	468	140	242	14,900	C.
August	680	54	141	8,670	A.
September	114	54	67.6	4,020	C.
October	54	54	54.0	3,320	C.
November	54	42	46.0	2,740	C.
December	54	42	44.3	2,720	C.
The period				58,600	
1908.					
January	50	35	40.3	2,480	C.
February	68	35	40.7	2,340	C.
March	910	35	248	15,200	B.
April	418	50	268	15,900	B.
May	326	204	256	15,700	B.
June	242	89	169	10,100	B.
July	242	23	50.9	3,130	A.
August	570	7	56.8	3,490	B.
September	50	7	17.5	1,040	D.
October	68	23	33.6	2,070	C.
November	50	23	37.8	2,250	C.
December	35	14	29.2	1,800	C.
The year	910	7	104	75,500	

NOTE.—No corrections made in discharge on account of ice conditions during 1908. Effect due to ice probably small.

GRAND RIVER DRAINAGE BASIN.

DESCRIPTION.

Grand River and its tributaries drain an area comprising approximately 26,000 square miles, of which 22,290 are in Colorado and the rest in eastern Utah. On the east and southeast the basin is limited by the high ranges of the Continental Divide, which separate it from the basins of Platte and Arkansas rivers; on the north by the White River and Book Cliffs plateaus; on the west by the canyon district of Green River.

Rising among the high peaks of the Rocky Mountains in the north-central portion of Colorado, the Grand flows in a southwesterly direction to its junction with Green River, traversing approximately 350 miles.

The tributaries include Fraser, Blue, Eagle, Williams Fork, Roaring Fork, Gunnison, and Dolores rivers, all of which enter from the south.

In most respects the Grand is a typical mountain stream, flowing throughout its course in a succession of deep canyons, with precipitous and ofttimes perpendicular walls, varying in height up to 3,000 feet above the water's edge, alternating with long, narrow, fertile valleys. The headwater region, comprising approximately 50 per cent of the basin, is extremely rugged, elevations ranging from 7,000 to 14,000 feet. Gradients are steep, stream channels are numerous, and tributaries are rapid, the fall varying from 20 to 150 feet. The intermediate or middle portion of the basin consists largely of broken and scarred plateaus of sedimentary origin. The lower drainage basin, that portion immediately east and west of the Colorado state line, is a dry, broken, much eroded region.

The rocks of the basin range from the granites and masses of igneous origin on the crest of the Continental Divide to the younger and less resistant sedimentaries of the plateau region. The soils of the upper basin, though shallow, generally contain considerable organic matter; those of the intermediate basin are largely decomposed and disintegrated sedimentary rocks; in the lower basin the soils consist of adobe clays and sandy loams, which grade imperceptibly from one to the other. The scant vegetation of the lower basin renders soil erosion large.

The precipitation ranges from 5 to 10 inches in the lower basin, 10 to 20 inches in the intermediate region, and 20 to 30 inches in the headwater region. By far the greater part of this is in the form of snow.

Notwithstanding heavy inroads, the forestation of the mountainous part of the basin, except in a few localities, is good—the equal of any in Colorado. The forest covering consists of spruce, quaking asp, cedar, and piñon. The intermediate basin is fairly well forested with quaking asp, cedar, and piñon. The forestation of the lower basin is poor, consisting of scattered pine, cedar, and piñon. The prevailing vegetation is sage brush, chico, and cactus pads.

The greater part of the timbered area in the Grand River basin above the Gunnison is included in the Arapahoe and Holy Cross National Forest. In these reserves in the Grand drainage basin there are about 1,400 square miles of merchantable timber land, 900 square miles of woodland, and about 800 square miles of burned area.

Extensive meadow lands are comprised within the upper basin. In the middle basin, or from the lower end of Gore Canyon to about Rifle, there are in contemplation about half a dozen small projects, which

will irrigate 30,000 to 35,000 acres. In the lower basin the Reclamation Service has under way the Grand Valley project, to cover an irrigable area of 60,000 to 70,000 acres. Under other schemes from 40,000 to 50,000 acres more will be irrigated. The Uncompahgre Valley project, which diverts water from the Gunnison, has finished structures capable of irrigating about 50,000 acres. The completed project will irrigate about 150,000 acres.

Natural storage within the basin is limited to a few high mountain lakes, of which Grand Lake is the largest. There are, however, reservoir sites along the Grand and its tributaries, which if utilized would make possible a development of 1,000,000 horsepower. The Kremmling reservoir site is by far the best in the drainage. It is located near the upper end of Gore Canyon, and with a 230-foot dam, water to the extent of about 2,200,000 acre-feet could be impounded. A standard-gage railroad now runs through this site.

Until recently the splendid power resources of this drainage basin have remained practically untouched. The estimated power which can be developed, including Dolores and Gunnison rivers, is as follows:

Minimum horsepower	540,000
Minimum horsepower (6 high months)	1,000,000
Horsepower from storage (6 months' period)	1,600,000

Of this amount less than 40,000 horsepower has so far been developed. With its numerous large tributaries, rising at high elevations, this stream affords more favorable opportunities for power development than any in Colorado.

Hot sulphur springs are located along the Grand River at two points—at Sulphur Springs, Colo., and at Glenwood Springs, Colo., and in both localities they increase the temperature of the river water. Their combined flow is probably less than 20 second-feet.

The years of maximum run-off in this drainage basin were 1897 and 1907; of the minimum run-off since records were begun—1902.

Fraser, Eagle, Williams, and Roaring forks and Gunnison River are described in connection with gaging stations now maintained. The importance of Dolores River entitles it to the following brief description, although measurements have been discontinued.

The Dolores rises in the La Plata and San Miguel mountains, whose highest peak, Mount Wilson, attains an elevation of over 14,000 feet. Its course is southwesterly for about 50 miles, when it turns and flows almost due northerly for nearly 100 miles, when it again turns to the west and enters Grand River about 15 miles west of the Colorado-Utah line. For the greater part of its course the river flows through deep canyons, and comparatively little irrigation is practiced along the stream itself. In the vicinity of Dolores, however, the valley broadens, and for about 40 miles has a width of one-half mile

to a mile. A considerable part of this area is cultivated. In the Paradox Valley, also, considerable land is cultivated, chiefly from small tributaries running into the main stream. By far the greater part of Dolores River water is used for irrigation in the San Juan drainage, being diverted by means of a tunnel and a great cut into the Montezuma Valley.

San Miguel River, the most important tributary of the Dolores, rises in San Miguel County, Colo., and drains an area immediately west of the headwaters of the Uncompahgre River, and enters the Dolores about 12 miles east of the Colorado-Utah line at an elevation of about 5,000 feet. The stream and its tributaries run for the most part in a northeasterly direction. Considerable land along the San Miguel has been irrigated and plans for increased development have been made. Probably 600 square miles of the Dolores River basin are covered with merchantable timber and as much more is woodland. The total area of this basin is about 4,500 square miles.

The mean annual run-off of Dolores River above the mouth of the San Miguel is nearly 400,000 acre-feet, while the San Miguel furnishes at least half that amount.

The basin contains several small storage reservoir sites, a few of which have been developed, both for power and irrigation. Theoretically, by utilizing storage it would be possible to develop from 75,000 to 100,000 horsepower in the Dolores drainage. The river has an average fall of over 20 feet per mile throughout almost its whole course, while a great stretch of the San Miguel averages over 50 feet to the mile. Several water-power plants are in operation along the upper San Miguel and its tributaries, the development aggregating nearly 10,000 horsepower, of which about 7,500 horsepower is developed at the Ames, the Howards Fork, and the Illium plants of the Telluride Power Company. One plant on Bridal Veil Creek is utilizing a head of 2,000 feet to develop 1,200 horsepower.

The following gaging stations have been maintained in the Grand River drainage basin:

North Fork of Grand River near Grand Lake Colo., 1904–1908.
Grand River near Granby, Colo., 1908.
Grand River at Sulphur Springs, Colo., 1904–1908.
Grand River near Kremmling, Colo., 1904–1908.
Grand River near Wolcott, Colo., 1906–1907.
Grand River at Glenwood Springs, Colo., 1899–1908.
Grand River near Palisades, Colo., 1902–1908.
Grand River near Grand Junction, Colo., 1895–1900.
North Inlet to Grand Lake at Grand Lake, Colo., 1905–1908.
Grand Lake Outlet at Grand Lake, Colo., 1904–1908.
Fraser River at Granby (Coulter), Colo., 1904–1908.
Williams Fork near Sulphur Springs, Colo., 1904–1908.
Troublesome River at Troublesome, Colo., 1904–1905.
Muddy River at Kremmling, Colo., 1904–1905.

Blue River near Kremmling, Colo., 1904–1908.
Tenmile Creek near Kokomo, Colo., 1904.
Tenmile Creek near Uneva Lake, Colo., 1903.
Eagle River near Eagle, Colo., 1905–1906.
Eagle River at Gypsum, Colo., 1907–1908.
Roaring Fork near Emma, Colo., 1908.
Roaring Fork at Glenwood Springs, Colo., 1906–1908.
Frying Pan River at Basalt, Colo., 1908.
Crystal River near Carbondale (Sewell), Colo., 1908.
Gunnison River near Iola, Colo., 1900–1903.
Gunnison River near Cimarron, Colo., 1903–1905.
Gunnison River at River Portal (east portal of Gunnison tunnel), Colo., 1905–1908.
Gunnison River near Cory, Colo., 1903–1905.
Gunnison River at Whitewater, Colo., 1897, 1902–1906.
Gunnison River near Grand Junction, Colo., 1895, 1897–1899.
Taylor River near Almont, Colo., 1905.
East River at Almont, Colo., 1905.
Cimarron Creek at Cimarron, Colo., 1903–1905.
North Fork of Gunnison River near Hotchkiss, Colo., 1903–1906.
Uncompahgre River near Colona, Colo., 1903–1906.
Uncompahgre River at Fort Crawford, Colo., 1895–99, 1908.
Uncompahgre River at Montrose, Colo., 1903–1908.
Uncompahgre River near Delta, Colo., 1903–1908.
Dolores River near Dolores, Colo., 1895–1903.
San Miguel River near Fall Creek, Colo., 1895–1899.

NORTH FORK OF GRAND RIVER NEAR GRAND LAKE, COLO.

This station, which was established July 29, 1904, to obtain data for use in connection with power development and for general run-off studies, is located at the highway bridge on the road between Grand Lake and Granby, and is about 3 miles southwest of Grand Lake postoffice, Colo. The nearest railroad is the Denver, Northwestern and Pacific, at Granby, Colo., distant about 12 miles.

It is located about 2 miles above Grand Lake outlet, which is the most important tributary of the North Fork.

One large ditch above the station diverts water into the headwaters of the Cache la Poudre, in the South Platte drainage basin.

Winter records at this station are more satisfactory than at the other stations on the headwaters of the Grand, as near-by springs tend to keep the stream at the gaging station more or less open.

The location and datum of the staff gage, which is at the bridge, have remained unchanged during the maintenance of the station.

Fairly good results have been obtained at this station. Because of the sluggish condition of the stream at low stages, measurements taken at such times are not entirely satisfactory.

Discharge measurements of North Fork of Grand River near Grand Lake, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	C. L. Chatfield	60	171	5.40	706
July 20	do	55	115	4.70	344
August 13	do	40	82	4.10	136
October 2	Freeman and Stewart	39	65	3.73	61
November 26[a]	J. B. Stewart	38	42	3.27	14
1908.					
January 29[b]	J. B. Stewart	38	49	3.30	16
February 26[b]	do	38	49	3.29	18.6
May 20	C. L. Chatfield	54	116	4.60	263
June 11	do	54	120	4.68	273
July 3	Hoyt and Freeman	50	101	4.45	219
July 27	C. L. Chatfield	40	81	3.98	92
August 17	do	40	79	4.00	98
September 17	do	44	79	3.63	36
October 22	do	44	76	3.50	20
November 23[c]	do	38	53	3.40	23
December 21[d]	do	32	53	4.10	15

[a] Measurement affected by ice conditions.
[b] Stream open at bridge but frozen over 20 feet below.
[c] Wading measurement.
[d] Measurement through ice.

Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1907 and 1908.

[Harry W. Carr, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	3.40	3.35	3.35	3.58	3.80	4.48	6.00	4.42	3.78	3.70	3.55	3.25
2	3.40	3.35	3.35	3.62	3.85	4.80	6.00	4.40	3.80	3.65	3.60	3.30
3	3.40	3.35	3.35	3.65	3.78	4.80	5.95	4.35	3.75	3.65	3.55	3.35
4	3.40	3.35	3.35	3.68	3.90	4.90	6.00	4.55	3.72	3.70	3.58	3.20
5	3.40	3.38	3.35	3.70	3.90	5.20	6.00	4.48	3.70	3.70	3.55	3.20
6	3.40	3.32	3.35	3.70	3.90	5.25	5.90	4.42	3.70	3.70	3.52	3.20
7	3.40	3.30	3.35	3.62	3.92	5.10	5.95	4.32	3.70	3.80	3.50	3.20
8	3.40	3.30	3.35	3.60	3.92	5.08	5.80	4.22	3.70	3.80	3.50	3.20
9	3.40	3.30	3.35	3.70	4.00	5.08	5.78	4.20	3.70	3.72	3.50	3.20
10	3.40	3.30	3.35	3.85	4.08	4.95	5.62	4.15	3.68	3.70	3.52	3.28
11	3.40	3.30	3.35	4.10	4.22	4.98	5.35	4.15	3.62	3.70	3.52	3.30
12	3.40	3.30	3.35	4.05	4.50	5.20	5.25	4.15	3.60	3.65	3.40	3.28
13	3.40	3.30	3.35	4.25	4.40	5.45	5.15	4.10	3.60	3.65	3.52	3.30
14	3.40	3.30	3.35	4.32	4.15	5.70	5.20	4.08	3.92	3.60	3.35	3.30
15	3.40	3.40	3.35	4.45	4.12	5.75	5.02	4.00	3.78	3.60	3.38	3.30
16	3.40	3.35	3.35	4.40	4.10	5.80	4.90	3.95	3.72	3.60	3.30	3.25
17	3.40	3.35	3.35	4.25	4.22	5.78	4.82	3.90	3.70	3.60	3.30	3.25
18	3.40	3.35	3.35	4.15	4.48	5.80	4.75	3.95	3.65	3.60	3.30	3.38
19	3.40	3.35	3.35	3.95	4.55	5.90	4.60	4.00	3.65	3.60	3.30	3.25
20	3.40	3.35	3.42	3.90	4.82	5.85	4.58	3.98	3.62	3.60	3.28	3.25
21	3.40	3.35	3.48	3.82	5.02	5.50	4.58	3.90	3.60	3.58	3.25	3.25
22	3.40	3.35	3.52	3.88	5.10	5.45	4.60	3.85	3.60	3.55	3.22	3.25
23	3.35	3.35	3.58	3.95	5.05	5.75	4.62	3.80	3.55	3.55	3.30	3.25
24	3.35	3.35	3.75	3.95	5.05	5.85	4.60	3.80	3.55	3.55	3.30	3.25
25	3.35	3.35	3.75	3.90	4.90	5.85	4.58	3.90	3.52	3.55	3.25	3.25
26	3.35	3.35	3.72	3.98	4.68	5.85	4.65	3.90	3.68	3.55	3.30	3.25
27	3.35	3.38	3.75	4.08	4.62	5.85	4.90	3.88	3.72	3.55	3.30	3.25
28	3.35	3.35	3.68	4.10	4.58	5.90	4.80	3.82	3.65	3.55	3.30	3.28
29	3.35	.....	3.70	4.10	4.55	5.95	4.65	3.80	3.55	3.55	3.30	3.30
30	3.35	.....	3.62	3.92	4.52	6.00	4.55	3.80	3.65	3.55	3.30	3.30
31	3.35	.....	3.68	.....	4.50	.....	4.50	3.75	.....	3.55	.....	3.30

[a] Ice conditions probably prevailed during the greater part of January, February, and March and from about November 12 to December 31, 1907. In some cases morning readings were affected by ice and afternoon readings were used.

Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	3.3	3.4	3.3	3.35	3.9	4.4	4.5	4.15	3.7	3.6	3.4	3.6
2	3.35	3.4	3.45	3.45	4.0	4.35	4.5	4.0	3.7	3.6	3.45	3.95
3	3.3	3.3	3.6	3.4	4.1	4.4	4.5	4.0	3.7	3.6	3.45	3.4
4	3.3	3.3	3.3	3.4	4.0	4.65	4.5	3.95	3.7	3.6	3.5	3.4
5	3.3	3.3	3.3	3.4	3.9	4.7	4.6	3.95	3.7	3.6	3.4	.....
6	3.3	3.35	3.4	3.5	4.05	4.7	4.5	3.95	3.7	3.6	3.4	3.4
7	3.35	3.3	3.6	3.45	4.1	4.55	4.4	4.0	3.65	3.6	3.4	.....
8	3.3	3.3	3.55	3.55	4.3	4.5	4.4	3.9	3.65	3.6	3.4	3.4
9	3.3	3.35	3.5	3.6	4.2	4.5	4.4	3.85	3.65	3.55	3.4	.....
10	3.3	3.3	3.6	3.7	4.2	4.65	4.35	3.9	3.65	3.55	3.4	3.4
11	3.3	3.3	3.45	4.0	4.1	4.7	4.4	4.4	3.65	3.55	3.45	.....
12	3.3	3.3	3.5	4.05	4.1	4.95	4.35	4.4	3.65	3.55	3.45	3.4
13	3.3	3.35	3.3	4.1	4.05	4.7	4.3	4.25	3.75	3.55	3.95	3.4
14	3.3	3.35	3.3	4.15	4.0	4.85	4.3	4.1	3.8	3.55	4.05	.....
15	3.3	3.3	3.3	4.2	4.0	5.0	4.5	4.0	3.7	3.55	3.9	3.4
16	3.4	3.3	3.3	4.15	4.15	5.0	4.3	4.0	3.7	3.55	3.7	.....
17	3.3	3.35	3.3	4.1	4.2	5.0	4.3	3.95	3.65	3.55	3.75	3.35
18	3.3	3.35	3.3	4.1	4.3	4.85	4.2	3.9	3.6	3.55	3.75	.....
19	3.3	3.3	3.35	4.2	4.5	4.6	4.15	4.1	3.6	3.55	3.75	3.4
20	3.3	3.35	3.55	4.2	4.6	4.8	4.1	4.1	3.55	3.5	3.75	.....
21	3.3	3.35	3.5	4.2	4.4	4.95	4.1	4.1	3.55	3.5	3.8	4.1
22	3.3	3.4	3.4	4.3	4.3	5.0	4.05	4.1	3.55	3.45	3.5	.....
23	3.3	3.35	3.35	4.25	4.3	5.0	4.05	4.0	3.55	3.45	3.4	3.35
24	3.3	3.3	3.4	4.1	4.35	4.85	4.05	4.0	3.55	3.4	3.7	.....
25	3.3	3.3	3.35	4.05	4.35	4.85	4.0	3.9	3.55	3.4	3.8	3.35
26	3.3	3.3	3.35	3.9	4.35	4.85	4.0	3.85	3.55	3.4	3.5	.....
27	3.4	3.4	3.3	4.0	4.35	4.8	4.0	3.8	3.55	3.6	3.75	3.35
28	3.3	3.5	3.3	3.95	4.3	4.7	4.0	3.8	3.55	3.6	3.7	.....
29	3.3	3.3	3.5	3.9	4.3	4.6	4.0	3.8	3.6	3.5	3.5	3.35
30	3.3	.....	3.3	3.9	4.3	4.55	4.1	3.8	3.6	3.45	3.4	.....
31	3.3	.....	3.3	.....	4.3	.....	4.35	3.7	.....	3.4	.....	3.35

[a] Ice conditions probably prevailed during the greater part of January, February, and March and from about November 13 to December 31, 1908.

Rating tables for North Fork of Grand River near Grand Lake, Colo.

JANUARY 1, 1907, TO APRIL 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	10	4.00	105	4.70	347	5.40	702
3.30	16	4.10	130	4.80	390	5.30	767
3.40	24	4.20	160	4.90	434	5.60	834
3.50	33	4.30	194	5.00	479	5.70	902
3.60	43	4.40	230	5.10	528	5.80	970
3.70	55	4.50	267	5.20	582	5.90	1,040
3.80	69	4.60	306	5.30	640	6.00	1,110
3.90	85						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 5 discharge measurements made during 1907 and the form of previous curves. It is well defined.

APRIL 11 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	12	3.90	77	4.30	165	4.70	304
3.50	20	4.00	95	4.40	195	4.80	343
3.60	32	4.10	116	4.50	230	4.90	383
3.70	45	4.20	140	4.60	266	5.00	425
3.80	59						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and the form of the 1907 curve and is well defined.

Monthly discharge of North Fork of Grand River near Grand Lake, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.[a]					
January	24	20	22.8	1,400	D.
February	24	16	19.1	1,060	D.
March	62	20	31.1	1,910	C.
April	248	41	104	6,190	A.
May	528	66	235	14,400	A.
June	1,110	260	764	45,500	A.
July	1,110	267	603	37,100	A.
August	286	62	132	8,120	A.
September	89	35	52.3	3,110	A.
October	69	38	46.6	2,870	A.
November	43	13	24.4	1,450	D.
December	22	10	13.9	855	D.
The year	1,110	10	171	124,000	
1908.[b]					
January	24	16	16.8	1,030	D.
February	33	16	18.9	1,090	D.
March	43	16	24.3	1,490	D.
April	165	20	87.7	5,220	A.
May	266	77	145	8,920	A.
June	425	179	319	19,000	A.
July	266	95	162	9,960	A.
August	195	45	96.3	5,920	A.
September	59	26	36.5	2,170	A.
October	32	12	24.6	1,510	B.
November			16.4	976	D.
December			15.2	935	D.
The year			80.2	58,200	

[a] The open channel rating was applied throughout 1907. The error in second-feet due to ice conditions is relatively small, but the percentage error may be great.

[b] The open channel rating was applied during January to March, 1908. See above footnote 1907. Ice conditions November 13 to December 31, 1908, and discharge estimated.

GRAND RIVER NEAR GRANBY, COLO.

This station was established June 10, 1908, by the Central Colorado Power Company, to obtain data for determining the flow of the South Fork in connection with storage and power development. It was taken over as a United States Geological Survey station on July 1, 1908. The gage is located at a highway bridge, which crosses the river about 4 miles from Granby on the road to Grand Lake. Measurements are made by means of a cable equipment located 300 feet downstream from the bridge.

It is about 4 miles below the junction of North and South forks, about the same distance above the mouth of Fraser River, and is above the mouth of Willow Creek. The drainage area is about 500 square miles.

No important diversions are made on the South Fork or on the main stream above the station. This stream affords excellent storage possibilities. Several filings for power development have been made above this station, but additional opportunities for filing no doubt exist. A small power plant is located on a tributary of the South Fork.

Thick ice covers the river for about four months each year, and anchor ice also occurs.

The location and datum of the gage have remained unchanged during the maintenance of the station.

Discharge measurements of Grand River near Granby, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 12	C. L. Chatfield	110	312	3.90	1,380
July 2	Hoyt and Freeman	102	225	3.00	732
July 26	C. L. Chatfield	95	146	2.30	304
August 16	do	100	172	2.50	419
September 16	do	90	113	1.75	147
October 20 [a]	W. H. Snelson, jr	85	88	1.50	105
October 21 [a]	C. L. Chatfield	85	94	1.50	84
October 23 [a]	do	85	96	1.47	82
November 22 [b]	do	60	42	1.55	72
December 20 [b]	do	35	38	2.10	51

[a] Wading measurement at cable section.
[b] Wading measurement below bridge. River frozen at cable.

Daily gage height, in feet, of Grand River near Granby, Colo., for 1908.

[J. P. Switzer, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.05	2.8	1.9	1.6	1.5	1.7	16	3.85	2.85	2.5	1.8	1.5	1.45	2.1
2	.....	3.05	2.65	1.9	1.6	1.45	1.65	17	3.9	2.8	2.4	1.8	1.5	1.4	2.2
3	.....	3.05	2.6	1.85	1.6	1.45	1.8	18	3.8	2.65	2.4	1.65	1.5	1.4	2.15
4	.....	3.1	2.5	1.75	1.6	1.45	1.8	19	3.4	2.55	2.4	1.6	1.5	1.3	2.15
5	.....	3.1	2.4	1.7	1.6	1.45	1.8	20	3.45	2.5	2.4	1.6	1.5	1.3	2.15
6	.....	3.1	2.3	1.7	1.6	1.45	1.8	21	3.7	2.45	2.5	1.6	1.5	1.4	2.15
7	.....	3.05	2.3	1.7	1.6	1.45	1.6	22	3.95	2.4	2.6	1.6	1.5	1.4	2.2
8	.....	3.05	2.25	1.7	1.6	1.45	1.8	23	3.9	2.4	2.6	1.6	1.5	1.4	2.25
9	.....	3.0	2.1	1.7	1.6	1.45	1.75	24	3.75	2.4	2.6	1.55	1.5	1.35	2.3
10	3.4	3.0	2.1	1.7	1.6	1.45	1.8	25	3.75	2.3	2.45	1.5	1.5	1.55	2.3
11	3.5	2.95	2.5	1.7	1.6	1.4	1.9	26	3.65	2.3	2.3	1.55	1.5	1.55	2.2
12	3.85	2.95	2.9	1.7	1.55	1.35	1.9	27	3.7	2.3	2.2	1.6	1.5	1.3	2.2
13	3.7	2.9	2.8	1.7	1.5	1.4	1.95	28	3.5	2.3	2.2	1.6	1.45	1.55	2.25
14	3.65	2.9	2.7	1.8	1.5	1.4	1.85	29	3.35	2.3	2.1	1.6	1.45	1.6	2.3
15	3.8	2.95	2.6	1.8	1.5	1.5	2.15	30	3.3	2.55	2.0	1.6	1.5	1.7	2.2
								31	.....	2.8	1.95	.....	1.5	.....	2.25

NOTE.—Ice conditions November 21 to December 31.

Rating table for Grand River near Granby, Colo., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	54	2.00	207	2.70	515	3.40	995
1.40	70	2.10	240	2.80	575	3.50	1,070
1.50	88	2.20	276	2.90	640	3.60	1,150
1.60	108	2.30	316	3.00	710	3.70	1,230
1.70	130	2.40	359	3.10	780	3.80	1,310
1.80	153	2.50	406	3.20	850	3.90	1,390
1.90	178	2.60	458	3.30	920	4.00	1,475

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during 1908 and is well defined.

Monthly discharge of Grand River near Granby, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 10–30	1,430	920	1,200	50,000	A.
July	780	316	559	34,400	A.
August	640	192	380	23,400	A.
September	178	88	127	7,560	B.
October	108	79	94.8	5,830	B.
November	88	54	71.1	4,230	C.
December	70	50	55.6	3,420	C.
The period				129,000	

NOTE.—Ice conditions and discharge estimated November 21 to December 31.

GRAND RIVER AT SULPHUR SPRINGS, COLO.

This station was originally established July 27, 1904, at the highway bridge one-eighth mile below Sulphur Springs. On April 17, 1906, it was moved to the new highway bridge, about 1,000 feet above the old location, and a standard chain gage was installed. This gage has no determined relation to the old gage. The data obtained are used to check up the results at other stations on Grand River and its tributaries, and also to determine the flow of some of the smaller tributaries.

The Grand is joined by Fraser River about 10 miles above Sulphur Springs, and by Williams Fork a few miles below. The drainage area at the station is about 950 square miles.

A number of small private ditches divert water for meadow irrigation along the principal tributaries above the station and along the Grand. A number of large diversion ditches are located in the lower drainage basin. Filings for power development are numerous from source to mouth, but it is probable that a large amount of this water would still be available for appropriation for irrigation.

The river at the station freezes across for about four months each year, the ice sometimes reaching a depth of 2 feet. No artificial control is used.

On account of unfavorable measuring conditions during the winter months at the regular section, temporary gages have been maintained in a canyon one-quarter mile below, where the river is open and where measurements can be made by wading. A temporary gage was used from January 25 to March 17, 1908, and another, 200 feet nearer the regular station, from November 25 to December 20, 1908. From April 1 to 16, 1908, an old staff gage was read by the observer instead of the chain gage. Gage heights for this period have been adjusted to refer to the chain-gage datum. Beginning December 22, 1908, readings were resumed at the chain gage by gaging through a hole cut in the ice.

The accuracy of the results obtained at this station is affected to a certain extent by a bend in the river above the station, the bridge pier, and by ice conditions.

Discharge measurements of Grand River at Sulphur Springs, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	C. L. Chatfield	112	261	2.90	1,020
April 26	do	106	202	2.40	533
May 28	W. B. Freeman	131	397	3.98	2,120
June 21	C. L. Chatfield	289	773	5.85	4,640
July 18	do	132	395	4.10	1,890
August 10	do	111	231	2.60	710
September 30	Freeman and Stewart	107	145	1.87	259
1908.					
January 15 [a]	R. I. Meeker	45	40	.....	101
January 25 [a]	J. B. Stewart	44	65	.....	94
January 26 [a]	do	51	49	[b] 1.13	100
February 22 [a]	C. L. Chatfield	50	47	[b] 1.05	76
February 28 [a]	J. B. Stewart	60	63	[b] 1.05	89
March 17 [a]	C. L. Chatfield	65	77	[b] 1.35	161
April 17	do	104	210	2.45	569
May 25	do	112	298	3.31	1,140
June 13	do	121	447	4.47	2,170
July 4	Hoyt and Freeman	114	288	3.35	1,090
July 25	C. L. Chatfield	106	190	2.35	485
July 29	do	106	179	2.20	434
August 15	do	111	217	2.60	617
September 18	do	98	126	1.75	198
October 20	do	98	119	1.65	166
November 24 [c]	do	56	120	1.50	120
December 22 [a]	do	29	66	[d] 2.25	109

[a] Wading measurement in canyon. Frozen at regular section.
[b] Temporary gage one-fourth mile below regular section. Gage washed out during the measurement on March 17, 1908.
[c] Frozen at regular section. Wading 600 feet above bridge. Current full of slush ice.
[d] Temporary gage in canyon, about 200 feet above gage used January to March, 1908. Chain gage at regular section read 3.20 feet.

Daily gage height, in feet, of Grand River at Sulphur Springs, Colo., for 1907 and 1908.

[E. L. Chatfield, jr., observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
1907.[a]												
1				2.00	2.62	3.65	6.05	3.48	2.18	1.98	1.68	.....
2				2.12	2.48	4.05	6.02	3.35	2.12	2.00	1.70	.....
3				2.45	2.48	4.95	5.95	3.18	2.00	2.05	1.78	.....
4				2.38	2.58	4.75	5.92	3.32	1.95	1.98	1.80	.....
5				2.18	2.52	5.30	5.82	3.35	2.00	2.05	1.82	.....
6				2.20	2.55	5.75	5.70	3.32	1.92	2.08	1.80	.....
7				2.00	2.62	5.55	5.62	3.18	1.90	2.00	1.80	.....
8				2.12	2.68	5.45	5.55	3.10	1.98	1.90	1.72	.....
9				2.37	2.62	5.38	5.45	2.58	1.92	1.82	1.68	.....
10				2.77	2.75	5.05	5.42	2.48	1.88	1.88	1.80	.....
11				3.07	3.00	5.05	5.38	2.38	1.82	1.82	1.80	.....
12				3.17	3.40	5.15	4.85	2.42	1.78	1.88	1.82	.....
13				3.07	3.40	5.85	4.75	2.60	1.75	1.82	.....	.....
14				3.07	3.20	5.95	5.20	2.58	1.78	1.82	.....	.....
15				3.42	3.12	6.00	4.75	2.50	1.82	1.85	.....	.....
16				3.52	3.10	6.22	4.32	2.45	1.78	1.90	.....	.....
17				3.12	3.18	6.00	4.20	2.42	1.80	1.92	.....	.....
18				3.07	3.20	6.05	4.00	2.42	1.78	1.92	.....	.....
19				3.82	3.50	6.28	3.85	2.40	1.75	1.98	.....	.....
20				3.27	4.45	6.05	3.90	2.35	1.68	2.08	.....	.....
21				2.37	4.50	5.85	3.78	2.38	1.65	2.12	.....	.....
22				2.42	4.85	5.90	3.82	2.42	1.68	2.02	.....	.....
23				2.47	4.75	5.75	3.72	2.22	1.62	2.10	.....	.....
24				2.42	5.22	5.55	3.72	2.18	1.65	2.18	.....	.....
25			2.68	2.37	4.75	6.05	3.78	2.18	1.60	2.28	.....	.....

[a] Ice conditions prevailed from about January 1 to March 24, and November 13 to December 31, 1907.

Daily gage height, in feet, of Grand River at Sulphur Springs, Colo., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
26			2.55	2.44	4.55	5.05	3.88	2.12	1.82	2.08		
27			2.25	2.58	4.05	5.95	4.25	2.18	1.75	1.72		
28			2.02	2.82	4.05	5.85	4.08	2.18	1.85	1.58		
29			1.85	2.75	3.95	5.75	3.88	2.18	1.98	1.55		
30			1.80	2.68	3.95	5.95	3.80	2.20	1.92	1.70		
31			1.88		3.80		3.68	2.20		1.72		
1908.[a]												
1		1.1		2.4	2.4	3.2	3.4	2.9	2.0	1.75	1.6	2.0
2			1.0	2.45	2.35	3.25	3.4	2.7	1.95	1.7	1.6	2.0
3		1.05		2.3	2.45	3.5	3.3	2.6	1.9	1.7	1.55	2.1
4			1.05	2.2	2.5	3.95	3.3	2.5	1.8	1.75	1.6	2.1
5		1.0		2.25	2.4	4.0	3.3	2.4	1.8	1.75	1.55	2.15
6			1.1	2.25	2.3	4.0	3.25	2.3	1.8	1.7	1.5	2.1
7		1.0		2.2	2.3	3.95	3.2	2.3	1.8	1.7	1.5	2.2
8			1.05	2.25	2.75	3.8	3.15	2.25	1.75	1.7	1.5	2.3
9		1.05		2.25	2.9	3.6	3.1	2.2	1.8	1.7	1.5	2.4
10			1.05	2.3	2.85	3.95	3.05	2.2	1.85	1.7	1.5	2.4
11		1.0		2.3	2.65	4.35	3.0	2.3	1.8	1.6	1.55	2.35
12			1.1	2.35	2.6	4.8	3.0	2.9	1.8	1.6	1.5	2.4
13		1.0		2.35	2.55	4.5	3.0	2.8	1.9	1.7	1.4	2.3
14			1.2	2.4	2.55	4.4	3.05	2.7	1.9	1.6	1.55	2.3
15		.95		2.4	2.5	4.6	3.1	2.6	1.9	1.6	1.7	2.25
16			1.3	2.45	2.5	4.75	3.05	2.55	1.85	1.6	1.7	2.2
17		1.0	1.35	2.45	2.85	4.8	2.8	2.4	1.8	1.65	1.75	2.2
18				2.45	3.0	4.5	2.65	2.35	1.75	1.6	1.75	2.2
19		1.0	1.7	2.5	3.2	4.0	2.65	2.4	1.7	1.65	1.7	2.2
20				2.5	3.5	3.8	2.55	2.5	1.7	1.6	1.7	2.2
21		1.0	1.8	2.6	3.3	4.25	2.5	2.5	1.7	1.6	1.7	[b]
22		1.05		2.6	3.1	4.5	2.5	2.5	1.7	1.6	1.65	2.25
23		1.0	1.9	2.55	3.05	4.55	2.5	2.6	1.7	1.55	1.7	3.3
24				2.55	3.15	4.4	2.5	2.5	1.6	1.6	1.65	3.1
25		.95	2.0	2.6	3.25	4.3	2.4	2.4	1.65	1.7	2.4	2.9
26	1.15			2.5	3.25	4.15	2.3	2.3	1.7	1.6	2.35	3.0
27		.95	2.1	2.5	3.1	4.1	2.35	2.25	1.7	1.6	2.3	2.8
28	1.1	1.05		2.4	3.1	4.05	2.3	2.2	1.7	1.6	2.15	2.8
29		1.0	2.25	2.25	3.1	3.7	2.25	2.1	1.7	1.6	2.1	2.7
30	1.1			2.35	2.95	3.6	2.2	2.1	1.75	1.6	2.15	2.3
31			2.4		3.05		2.95	2.05		1.6		2.6

[a] Temporary gages in canyon used January 26–March 16 and November 25–December 20, 1908. Gage heights estimated March 19–31. Ice conditions prevailed at the regular gage from about January 1 to the middle of March and from about November 15 to Dec. 31, 1908.

[b] Ice jam at regular station.

Rating tables for Grand River at Sulphur Springs, Colo.

APRIL 17, 1906, TO JUNE 15, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	280	2.80	905	3.80	1,960	4.80	3,400
1.90	325	2.90	990	3.90	2,090	4.90	3,550
2.00	375	3.00	1,080	4.00	2,220	5.00	3,700
2.10	430	3.10	1,175	4.10	2,360	5.20	4,000
2.20	490	3.20	1,275	4.20	2,500	5.40	4,310
2.30	550	3.30	1,375	4.30	2,650	5.60	4,630
2.40	615	3.40	1,480	4.40	2,800	5.80	4,950
2.50	680	3.50	1,590	4.50	2,950	6.00	5,270
2.60	750	3.60	1,710	4.60	3,100	6.20	5,590
2.70	825	3.70	1,830	4.70	3,250		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1906–7.

JUNE 16 TO AUGUST 31, 1907.

[The indirect method for shifting channels used.]

Rating tables for Grand River at Sulphur Springs, Colo.—Continued.

SEPTEMBER 1 TO NOVEMBER 12, 1907, AND MARCH 18 TO NOVEMBER 14, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	92	2.40	528	3.40	1,211	4.40	2,159
1.50	119	2.50	586	3.50	1,290	4.50	2,270
1.60	150	2.60	648	3.60	1,373	4.60	2,385
1.70	185	2.70	712	3.70	1,459	4.70	2,505
1.80	226	2.80	778	3.80	1,548	4.80	2,631
1.90	271	2.90	846	3.90	1,642	4.90	2,763
2.00	320	3.00	916	4.00	1,740	5.00	2,900
2.10	370	3.10	987	4.10	1,841		
2.20	421	3.20	1,060	4.20	1,944		
2.30	473	3.30	1,134	4.30	2,050		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on thirteen discharge measurements made during period, July, 1907 to November, 1908, and is well defined.

JANUARY 26 TO MARCH 17, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.95	63	1.10	93	1.30	147	.....	.....
1.00	72	1.20	118	1.40	180	.....	.....

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during winter 1907–8 and is applicable to gage heights at temporary gage in canyon. It is fairly well defined.

NOVEMBER 25 TO DECEMBER 22, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	99	2.20	106	2.30	112	2.40	120
2.10	102						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during winter 1908–9, and is applicable to gage heights at temporary gage in canyon. It is not well defined.

Daily discharge, in second-feet, of Grand River at Sulphur Springs, Colo., June 16 to August 31, 1907.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	.....	4,670	1,340	11	.....	3,620	570	21	4,640	1,600	543
2	.....	4,630	1,240	12	.....	2,900	590	22	4,660	1,630	564
3	.....	4,530	1,100	13	.....	2,740	700	23	4,450	1,550	452
4	.....	4,440	1,220	14	.....	3,320	685	24	4,170	1,550	425
5	.....	4,300	1,240	15	.....	2,740	630	25	4,770	1,600	425
6	.....	4,140	1,220	16	5,540	2,170	592	26	4,770	1,700	391
7	.....	3,990	1,120	17	5,120	2,030	573	27	4,630	2,080	420
8	.....	3,890	1,040	18	5,130	1,830	575	28	4,400	1,900	418
9	.....	3,750	690	19	5,430	1,660	560	29	4,290	1,710	413
10	.....	3,680	630	20	5,000	1,710	530	30	4,570	1,630	420
								31	.....	1,520	420

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Grand River at Sulphur Springs, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off, (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 25–31	810	280	476	6,610	B.
April	1,990	375	863	51,400	B.
May	4,030	667	1,710	105,000	A.
June	5,430	1,770	4,390	261,000	B.
July	4,670	1,520	2,750	169,000	B.
August	1,340	391	701	43,100	B.
September	411	150	246	14,600	A.
October	443	134	288	17,700	A.
November 1–12	235	178	213	5,070	A.
The period				673,000	
1908.					
January			99.2	6,100	C.
February	93	63	73.5	4,230	B.
March	528	72	198	12,200	B.
April	648	421	529	31,500	A.
May	1,290	473	805	49,500	A.
June	2,630	1,060	1,880	112,000	A.
July	1,210	421	819	50,400	A.
August	846	345	553	34,000	A.
September	320	150	220	13,100	A.
October	206	134	166	10,200	A.
November	150	92	125	7,440	C.
December			109	6,700	C.
The year			465	337,000	

NOTE.—Discharge estimated for periods, January 1–25, November 15–24, and December 23–31, 1908; ice conditions. See also footnotes to gage heights.

GRAND RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904. It is located at the upper end of Gore Canyon, about 3 miles southwest of Kremmling, Colo., near the Kremmling reservoir dam site, which is the largest in Colorado.

The records obtained at this station show the water available for storage and power development and are used also to determine probable run-off of some of the smaller tributaries between Kremmling and Sulphur Springs.

Blue River, the largest tributary above this station, empties into the Grand about 2 miles above. Other important tributaries between Kremmling and Sulphur Springs are Williams Fork, Troublesome, and Muddy rivers.

A number of private ditches divert water for meadow irrigation from both the main stream and its tributaries between Sulphur Springs and this station.

The river is frozen completely across at the station for about four months each year. During this period the records are affected by the surface ice and also by anchor ice forming in the riffle just below the gage.

On October 18, 1906, the present slope gage was established on the opposite side of the river from the old chain gage. The zero of

the slope gage is about 0.70 foot above the zero of the old gage. Measurements of discharge are made from a cable a few feet downstream from the gage.

Scouring during high stages and silting during low stages affect the accuracy of results. Data obtained are good at high and medium stages, but at low stages are not so accurate.

Discharge measurements of Grand River near Kremmling, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 19 [a]	R. I. Meeker	97	173	0.82	346
April 25	C. L. Chatfield	122	992	4.75	1,660
May 27	W. B. Freeman	138	1,850	9.85	4,960
June 19	C. L. Chatfield	160	2,680	15.40	9,500
July 16	do	140	1,840	9.95	4,870
August 9	do	124	1,230	4.35	1,580
September 28	W. B. Freeman	106	436	2.53	816
November 21 [b]	J. B. Stewart	101	205	.99	410
1908.					
January 21 [a]	J. B. Stewart	104	164	.68	304
January 22 [a]	do	104	146	.68	292
February 23 [a]	C. L. Chatfield	98	142	.96	268
March 2 [a]	J. B. Stewart	100	168	1.15	344
April 18	C. L. Chatfield	120	818	5.04	1,740
May 23	do	127	1,240	7.02	2,820
June 15	do	142	2,040	11.10	6,230
July 6	Hoyt and Freeman	127	1,450	6.98	2,740
July 23	C. L. Chatfield	92	1,110	4.10	1,280
August 20	do	115	1,000	4.10	1,410
September 19	do	105	254	1.60	545
October 24	do	105	250	1.50	472
November 25 [c]	do	100	167	.80	328
December 23 [d]	do	100	197	1.40	283

[a] Measurement through ice. [b] River filled with ice floats. [c] Floating ice. [d] Ice conditions.

Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1907 and 1908.

[H. A. Howe, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	0.89	.....	0.78	2.28	5.14	8.77	14.78	6.98	3.50	2.62	1.80	0.45
2	1.16	.....	.88	2.64	4.49	9.26	15.30	6.78	3.25	2.65	1.70	.35
3	1.90	.....	.94	3.71	4.30	11.13	14.50	6.55	3.15	2.58	1.50	.30
4	.....	.....	1.02	3.70	4.37	11.49	14.10	6.70	2.90	2.45	1.50	.20
5	.....	.....	1.16	3.81	4.26	11.90	13.95	6.95	2.85	2.55	1.42	.15
6	.....	.....	1.26	3.46	4.49	13.05	13.78	6.25	2.92	2.65	1.32	.25
7	.....	.....	1.30	2.96	4.92	13.38	13.38	5.75	2.80	2.95	1.38	.45
8	.....	.....	1.30	2.69	4.88	13.38	12.95	5.50	2.78	3.40	1.50	.60
9	.....	.....	1.42	2.98	4.75	13.05	12.75	5.35	2.62	2.98	1.48	.60
10	.....	.....	1.14	4.01	4.99	12.44	12.80	5.18	2.50	2.78	1.30	.60
11	.....	.....	1.35	5.92	5.78	11.70	12.52	5.00	2.38	2.58	1.20	.58
12	.....	.....	1.00	6.20	7.04	12.40	11.15	4.72	2.20	2.42	.75	.58
13	.....	.....	1.24	5.92	7.60	13.47	10.78	4.60	2.12	2.35	.45	.48
14	.....	.....	.99	6.32	7.02	14.28	11.78	4.45	2.30	2.30	.25	.52
15	.....	.....	.90	6.96	6.54	14.92	11.15	4.68	2.55	2.30	.95	.32
16	.....	.....	.86	7.28	6.34	15.35	9.95	4.70	2.65	2.20	1.30	.38
17	.....	.....	1.11	6.84	6.81	15.49	9.40	4.45	2.35	2.10	1.30	.35
18	.....	0.74	3.00	6.19	7.45	15.28	9.00	4.15	2.20	2.00	1.40	.28
19	.....	.82	4.38	5.68	8.42	15.47	8.65	4.30	2.08	1.95	1.18	−.02
20	.....	.77	5.79	4.62	9.84	15.38	8.35	4.25	1.98	1.90	.59	+.20
21	.....	.86	5.85	4.65	11.26	14.62	8.65	4.35	1.90	1.80	1.00	.25
22	.....	.92	6.50	4.70	12.30	13.95	8.62	4.05	1.85	1.80	.92	.40
23	.....	1.19	4.76	4.65	12.80	13.85	8.10	4.00	1.80	1.78	.75	.30
24	.....	1.12	3.96	4.69	12.62	14.25	8.10	3.70	1.80	1.70	.68	.55
25	.....	1.18	4.36	4.75	12.18	14.45	8.40	3.50	1.78	1.80	.80	.85

[a] Ice conditions probably prevailed during January, February, and the first part of March, 1907; December 24–31, 1907.

Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1907 and 1908— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
26	.....	1.11	4.82	4.46	11.06	14.82	8.88	3.78	2.10	1.80	1.00	1.10
27	.....	1.06	3.96	4.62	9.95	14.72	9.55	3.82	2.70	1.75	.79	.80
28	.....	.97	3.36	4.93	9.52	14.42	9.70	3.70	2.55	1.70	.62	.75
29	.....	.....	2.62	5.25	9.52	14.25	8.80	3.55	2.25	1.75	.58	.80
30	.....	.....	2.45	5.18	9.75	14.28	8.05	3.55	2.32	1.70	.55	.95
31	.....	.....	2.18	.....	9.31	.....	7.45	3.70	.....	1.60	.....	1.05
1908.[a]												
1	1.3	0.8	1.1	1.65	3.6	7.45	7.5	5.1	2.35	1.6	1.4	.65
2	1.2	.7	1.1	1.1	4.0	7.7	7.05	5.95	2.2	1.6	1.3	.4
3	1.15	.8	.95	1.1	4.9	7.9	7.0	4.55	2.1	1.6	1.05	.55
4	1.15	.8	1.0	1.8	5.5	9.0	6.95	4.2	2.0	1.6	1.1	.7
5	1.65	.85	1.1	1.7	4.85	9.3	7.0	3.7	1.95	1.55	1.15	1.15
6	1.85	.85	1.0	1.8	5.0	9.2	6.95	3.6	1.85	1.5	1.15	1.0
7	2.2	.9	.85	2.2	5.25	8.9	6.6	3.6	1.8	1.5	1.15	1.0
8	2.4	.9	.6	2.3	5.6	8.55	6.55	3.45	1.8	1.5	1.15	.7
9	2.15	.9	.8	2.3	6.3	8.55	6.35	3.2	1.75	1.4	1.15	.55
10	1.9	.9	.7	2.7	6.3	9.45	6.05	2.95	1.95	1.4	1.1	.65
11	1.85	.9	.8	3.1	5.7	10.45	6.1	3.35	2.15	1.4	1.25	.75
12	1.6	.95	.8	3.5	5.5	11.2	6.05	5.1	2.0	1.4	1.45	.65
13	1.55	.9	.95	3.85	5.4	10.9	5.95	4.95	2.05	1.3	1.15	.65
14	1.25	.9	1.55	4.15	5.1	10.65	5.95	4.85	2.3	1.25	.7	.9
15	1.05	1.0	1.75	4.8	4.9	10.9	6.1	4.3	2.2	1.2	.85	1.1
16	1.05	1.2	1.9	5.25	5.15	11.15	6.0	4.0	2.15	1.25	.9	1.2
17	.95	1.1	2.65	5.1	6.1	11.35	5.65	3.65	1.85	1.35	.8	.7
18	.9	1.05	2.15	4.95	6.6	10.75	5.25	3.75	1.7	1.4	.9	.85
19	.75	1.05	2.15	5.1	7.2	9.6	4.85	3.9	1.6	1.6	1.05	.6
20	.6	1.0	2.1	5.4	8.25	8.8	4.5	3.95	1.5	1.45	1.05	1.1
21	.7	1.1	1.3	5.6	7.9	9.2	4.25	4.3	1.45	1.25	1.0	1.05
22	.7	1.15	1.4	5.8	7.25	10.05	4.15	4.25	1.4	1.3	.95	.95
23	.7	1.0	1.45	6.1	7.1	10.2	4.2	4.35	1.3	1.15	1.05	1.2
24	.7	.95	1.65	5.6	7.2	9.9	4.2	4.2	1.3	1.3	.95	1.85
25	.9	1.1	1.9	5.0	7.9	9.7	4.15	3.8	1.45	1.5	.55	2.5
26	.8	1.05	2.0	4.4	7.65	9.3	3.8	3.55	1.5	1.45	.8	1.9
27	.8	1.1	2.3	4.1	7.3	9.3	3.7	3.45	1.6	1.1	.7	2.7
28	.7	1.1	2.1	4.1	7.2	9.25	3.6	3.25	1.6	1.1	.45	2.15
29	.75	1.0	1.9	3.7	6.65	8.2	3.6	3.0	1.6	1.35	.7	1.65
30	.8	.....	1.45	3.55	6.7	7.9	3.6	2.75	1.65	1.35	.95	1.55
31	.7	.....	1.1	.....	6.8	.....	4.65	2.55	.....	1.4	.....	1.3

[a] Ice conditions January 1 to March 20, and December 5 to 31, 1908.

Rating table for Grand River near Kremmling, Colo., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	170	1.40	490	2.80	890	5.40	1,940
.10	190	1.50	515	2.90	925	5.60	2,040
.20	210	1.60	540	3.00	960	5.80	2,140
.30	230	1.70	565	3.20	1,030	6.00	2,250
.40	250	1.80	590	3.40	1,100	7.00	2,825
.50	270	1.90	620	3.60	1,170	8.00	3,475
.60	290	2.00	650	3.80	1,240	9.00	4,220
.70	315	2.10	680	4.00	1,320	10.00	5,095
.80	340	2.20	710	4.20	1,400	11.00	6,120
.90	365	2.30	740	4.40	1,480	12.00	7,255
1.00	390	2.40	770	4.60	1,570	13.00	8,450
1.10	415	2.50	800	4.80	1,660	14.00	9,700
1.20	440	2.60	830	5.00	1,750	15.00	11,000
1.30	465	2.70	860	5.20	1,840	15.50	11,675

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906–8 and is well defined, except at stages below about 1.5 feet.

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Monthly discharge of Grand River near Kremmling, Colo., for 1907 and 1908.

[Drainage area, 2,380 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 18–28	438	325	384	.161	0.07	8,380	B.
March	2,520	335	874	.367	.42	53,700	A.
April	3,010	734	1,690	.710	.79	101,000	A.
May	8,210	1,420	3,680	1.55	1.79	226,000	A.
June	11,700	4,040	9,170	3.85	4.30	546,000	A.
July	11,400	3,120	6,220	2.61	3.01	382,000	A.
August	2,810	1,140	1,700	.714	.82	105,000	B.
September	1,140	585	784	.329	.37	46,700	A.
October	1,100	540	719	.302	.35	44,200	A.
November	590	220	407	.171	.19	24,200	B.
December	.....	.....	259	.109	.13	15,900	D.
The period	.....	.....	.....	.....	.....	1,550,000	
1908.							
January	.....	.....	304	.128	.15	18,700	D.
February	.....	.....	306	.129	.14	17,600	D.
March	740	.....	419	.176	.20	25,800	C.
April	2,300	415	1,290	.542	.60	76,800	A.
May	3,650	1,170	2,390	1.00	1.15	147,000	A.
June	6,510	3,120	4,720	1.98	2.21	281,000	A.
July	3,150	1,170	2,010	.845	.97	124,000	A.
August	2,220	815	1,310	.550	.63	80,600	A.
September	755	465	597	.251	.28	35,500	A.
October	540	415	488	.205	.24	30,000	B.
November	502	260	390	.164	.18	23,200	B.
December	.....	.....	303	.127	.15	18,600	D.
The year	6,510	.....	1,210	.508	6.90	879,000	

NOTE.—Ice conditions and discharge estimated for following periods, December 24–31, 1907; January 1 to March 20, 1908; and December 24–31, 1908.

Open-water rating applied to gage heights in February and March 1907, although there was probably ice in the river. The monthly means are probably not materially affected.

GRAND RIVER NEAR WOLCOTT, COLO.

This station, which was established May 27, 1906, and discontinued May 20, 1908, was located at the state bridge on the old stage road from Wolcott to Yampa. The Denver, Northwestern and Pacific Railroad now passes this bridge, the nearest station being McCoy.

The records at this station were used to check run-off data obtained at the station at Kremmling.

Piney River enters the Grand a few miles above and Rock Creek a few miles below the station. No important diversions are made between this and the Kremmling station. Between these two points the river has a fall of about 350 feet. Much of the power afforded by this fall has been filed upon.

Ice conditions are not as severe as at the Kremmling station.

The chain gage was located on the bridge and the datum remained the same during the maintenance of the station.

Results during high stages are good. Low-water measurements were made chiefly during the winter months and are not entirely satisfactory.

Discharge measurements of Grand River near Wolcott, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	W. B. Freeman	189	1,260	8.15	10,800
June 24	do	190	1,190	8.22	9,760
July 30	C. L. Chatfield	147	672	5.48	4,240
August 19	do	136	378	3.40	1,620
October 18	J. B. Stewart	83	268	2.30	763
November 21 [a]	do	78	216	1.57	294
1908.					
January 20 [b]	J. B. Stewart	73	252	[c] 1.50	381
March 1 [b]	do	68	199	1.38	334
June 14	C. L. Chatfield	199	989	6.85	6,560
July 6	Freeman and Hoyt	139	606	4.80	3,070

[a] Slush ice.
[b] Ice along edges.
[c] Reading at end of measurement, probably unaffected by ice. Mean gage height for measurement is doubtful.

NOTE.—Measurements for 1906 are given in Water-Supply Paper 211, p. 71.

Daily gage height, in feet, of Grand River near Wolcott, Colo., for 1907 and 1908.

[Edwin Crane, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907. [a]												
1	1.8	1.6	1.9	2.85	4.0	6.0	8.5	4.85	3.0	2.6	2.0	1.25
2	1.85	1.6	1.9	2.85	3.95	6.85	8.6	4.75	2.95	2.65	2.0	1.2
3	1.8	1.55	1.9	2.9	4.0	7.6	8.4	4.5	2.9	2.65	2.0	1.2
4	1.75	1.55	1.9	2.9	4.15	7.65	8.3	4.7	2.85	2.6	1.9	1.15
5	1.75	1.6	1.9	2.9	4.25	7.6	8.25	4.75	2.8	2.55	1.9	1.1
6	1.7	1.6	1.9	2.85	4.4	7.8	8.15	4.5	2.75	2.5	1.9	1.1
7	1.7	1.6	1.95	2.9	4.4	7.9	7.95	4.25	2.7	2.85	1.9	1.1
8	1.75	1.55	2.0	3.0	4.5	8.05	7.75	4.05	2.6	3.1	1.9	1.2
9	1.75	1.55	2.0	3.0	4.7	8.15	7.65	3.85	2.65	3.0	1.9	1.2
10	1.7	1.6	2.15	3.15	4.75	7.9	7.5	3.75	2.65	2.95	1.9	1.2
11	1.75	1.6	2.2	3.6	4.95	7.35	7.55	3.65	2.5	2.9	1.9	1.2
12	1.75	1.6	2.4	3.75	5.05	7.65	6.95	3.65	2.5	2.6	1.9	1.4
13	1.7	1.65	2.4	3.9	5.15	7.95	6.65	3.35	2.5	2.5	1.9	1.55
14	1.7	1.65	2.5	3.9	5.3	8.5	7.1	3.2	2.4	2.4	1.9	1.65
15	1.7	1.6	2.7	4.0	5.4	8.8	7.05	3.55	2.55	2.4	1.8	1.8
16	1.75	1.6	2.8	4.15	5.6	8.8	6.3	3.5	2.55	2.35	1.75	2.0
17	1.7	1.65	2.95	4.5	5.55	8.8	6.05	3.45	2.45	2.2	1.7	2.25
18	1.7	1.7	3.05	4.95	5.6	8.75	5.9	3.45	2.4	2.2	1.7	2.5
19	1.65	1.75	3.4	4.7	5.7	8.85	5.7	3.4	2.3	2.2	1.6	2.8
20	1.65	1.75	3.6	4.1	6.7	8.85	5.65	3.5	2.25	2.2	1.6	2.9
21	1.65	1.8	3.8	3.7	7.25	8.55	5.6	3.4	2.2	2.2	1.5	3.15
22	1.55	1.8	4.05	3.6	7.55	8.35	5.6	3.35	2.2	2.05	1.5	2.9
23	1.5	1.85	4.25	3.6	7.85	8.2	5.45	3.25	2.2	2.15	1.5	2.55
24	1.55	1.8	4.45	3.65	8.55	8.3	5.35	3.05	2.2	2.05	1.5	1.9
25	1.5	1.85	[b] 4.7	3.7	8.15	8.35	5.4	3.05	2.2	2.1	1.45	1.65
26	1.5	1.9	[b] 4.55	3.8	7.3	8.6	5.8	3.05	2.35	2.1	1.4	1.4
27	1.5	1.9	4.35	3.9	6.7	8.5	6.0	3.0	2.55	2.1	1.4	1.4
28	1.5	1.9	3.75	3.9	6.4	8.4	6.3	3.0	2.6	2.1	1.35	1.4
29	1.5	.....	3.3	4.0	6.4	8.3	5.75	3.05	2.45	2.0	1.3	1.4
30	1.5	.....	2.85	4.05	6.3	8.45	5.4	3.0	2.5	2.0	1.3	1.4
31	1.5	.....	2.85	.....	6.15	.....	4.95	3.0	.....	2.05	.....	1.4

[a] Ice conditions December 12 to 31, 1907. [b] Rise caused by dam going out at Monarch.

Daily gage height, in feet, of Grand River near Wolcott, Colo., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1908.[a]						1908.[a]					
1	1.6	2.1	1.4	1.8	3.15	16	2.2	1.6	2.0	3.95	4.0
2	1.7	1.8	1.4	1.7	3.35	17	2.1	1.5	2.2	3.8	4.05
3	1.7	1.8	1.4	1.7	3.7	18	1.6	1.5	2.3	3.9	4.5
4	1.5	1.5	1.4	1.8	4.1	19	1.5	1.5	2.3	3.9	4.8
5	1.6	1.6	1.5	2.0	3.9	20	1.9	1.5	2.3	4.1	5.5
6	2.0	1.5	1.5	2.2	3.95	21	1.4	1.5	2.3	4.2	.....
7	2.2	1.5	1.6	2.4	4.1	22	1.6	1.4	2.3	4.25	.....
8	2.8	1.5	1.6	2.45	4.15	23	1.4	1.4	2.3	4.4	.....
9	2.4	1.4	1.6	2.4	4.3	24	1.4	1.5	2.1	4.1	.....
10	2.8	1.4	1.4	2.6	4.45	25	1.5	1.4	2.1	3.75	.....
11	2.9	1.5	1.5	2.8	4.35	26	1.5	1.4	2.1	3.5	.....
12	1.4	1.5	1.5	3.1	4.15	27	1.7	1.4	2.2	3.4	.....
13	1.6	1.5	1.5	3.4	4.1	28	1.6	1.4	1.9	3.3	.....
14	2.1	1.4	1.7	3.4	4.0	29	1.7	1.4	1.8	3.35	.....
15	1.4	1.4	1.9	3.7	3.85	30	1.9	.....	1.7	3.25	.....
						31	2.1	.....	1.8	.....	.....

[a] Partial ice conditions January 1 to February 5, 1908.

Rating table for Grand River near Wolcott, Colo., for 1906 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	215	2.20	669	3.40	1,623	5.20	3,737
1.10	237	2.30	733	3.50	1,713	5.40	4,036
1.20	260	2.40	800	3.60	1,807	5.60	4,348
1.30	285	2.50	870	3.70	1,905	5.80	4,673
1.40	313	2.60	943	3.80	2,007	6.00	5,010
1.50	343	2.70	1,021	3.90	2,112	6.20	5,366
1.60	375	2.80	1,102	4.00	2,220	6.40	5,744
1.70	410	2.90	1,186	4.20	2,442	6.60	6,138
1.80	450	3.00	1,273	4.40	2,672	6.80	6,546
1.90	495	3.10	1,359	4.60	2,913	7.00	6,970
2.00	555	3.20	1,446	4.80	3,173	8.00	9,610
2.10	608	3.30	1,534	5.00	3,450	9.00	12,800

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906–1908 and is well defined, except below gage height 2.0 feet. This table supersedes all earlier rating tables.

Monthly discharge of Grand River near Wolcott, Colo., for 1906, 1907, and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1906.[a]					
May 27–31	7,790	6,340	6,960	69,000	A.
June	12,300	4,840	7,480	445,000	A.
July	5,370	1,860	3,440	212,000	A.
August	1,900	943	1,320	81,200	A.
September	2,010	733	1,200	71,400	A.
October	1,450	608	883	54,300	A.
November	800	410	553	32,900	B.
December	608	410	522	32,100	B.
The period	.....	.....	.....	998,000	

[a] The above monthly discharge for 1906 supersedes the values published in Water-Supply Paper 211.

Monthly discharge of Grand River near Wolcott, Colo., for 1906, 1907, and 1908—Cont'd.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.[a]					
January	472	343	397	24,400	D.
February	495	359	408	22,700	D.
March	3,040	495	1,300	79,900	A.
April	3,380	1,140	1,880	112,000	A.
May	11,300	2,170	4,870	299,000	A.
June	12,300	5,010	10,100	601,000	A.
July	11,500	3,380	6,700	412,000	A.
August	3,240	1,270	1,900	117,000	A.
September	1,270	669	896	53,300	A.
October	1,360	550	814	50,100	A.
November	550	285	425	25,300	C.
December			251	15,400	D.
The year			2,500	1,810,000	
1908.[b]					
January			353	21,700	D.
February			337	19,400	D.
March	733	313	491	30,200	C.
April	2,670	410	1,480	88,100	A.
May 1–20	4,190	1,400	2,390	94,800	A.
The period				254,000	

[a] Ice conditions December 12–31, 1907, and discharge estimated.
[b] Partial ice conditions January 1 to February 5, 1908, and discharge estimated.

GRAND RIVER AT GLENWOOD SPRINGS, COLO.

This station was established May 12, 1899, discontinued July 17, and reestablished January 7, 1900. It is located at Glenwood Springs. The gage is of the float type and is placed on the right bank of the river about one-fourth of a mile above the state bridge. Discharge measurements are made from a cable underneath this bridge (Pl. X, *B*, p. 182). (See Water-Supply Paper 175, pp. 81–82, for a detailed description of the gages used to date.)

This may be considered a base station, as the records show the entire run-off of the basin above the mouth of Roaring Fork. Ice never forms at this station, as the hot water from the nearby springs keeps the water above the freezing point even in the most severe weather. The winter records are, therefore, of especial value, as they furnish a basis for estimating approximately the discharge of the streams at other stations in the basin during the ice period.

The station is about one-fourth mile above Roaring Fork, which is the third largest tributary of the Grand.

A few minor irrigation ditches are taken out between this and the Kremmling station, but do not, however, affect the discharge to any appreciable extent. The Shoshone plant of the Central Colorado Power Company, having a head of 170 feet, was practically completed in 1908. The tail water from this plant is returned to the river above the gaging station.

The position and datum of this gage have remained unchanged.

Results at this station are satisfactory. Conditions have always been permanent except during 1907 and 1908, when the débris from the Shoshone plant was deposited in the river bed, thereby changing the rating of the stream.

Discharge measurements of Grand River at Glenwood Springs, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 6	R. I. Meeker	185	490	3.75	1,020
June 6	W. B. Freeman	217	1,670	9.10	16,200
June 23	do	220	1,700	9.53	17,100
July 29	C. L. Chatfield	214	1,210	7.20	7,450
August 17	do	205	770	5.30	2,930
October 16	J. B. Stewart	190	643	4.77	1,380
November 13	do	185	467	[a]3.60	747
1908.					
February 12 [b]	J. B. Stewart	185	458	3.47	738
April 12	do	193	694	4.62	1,740
May 11	C. L. Chatfield	.....	.....	5.80	3,870
June 21	do	215	1,250	7.10	7,420
July 8	Hoyt and Freeman	211	1,000	5.93	4,170
July 20	Freeman and Chatfield	198	809	5.17	2,580
August 24	C. L. Chatfield	200	770	5.11	2,160
September 23	do	185	507	4.05	934
October 28	do	185	508	4.35	882
December 1	do	183	414	3.88	690

[a] Gage height somewhat uncertain, owing to gage being out of order. [b] River entirely open.

Daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 1907 and 1908.

[W. H. Richardson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.35	3.42	3.62	4.28	5.60	7.35	9.92	6.55	4.93	4.50	4.50	3.58
2	3.12	3.50	3.62	4.25	5.48	7.45	9.90	6.43	4.90	4.55	4.50	3.55
3	3.10	3.48	3.55	4.42	5.38	7.80	9.78	6.27	4.83	4.53	4.45	3.48
4	3.08	3.48	3.65	4.75	5.25	8.50	9.70	6.25	4.80	4.65	4.40	3.42
5	3.48	3.48	3.70	4.82	5.28	8.80	9.58	6.40	4.75	4.60	4.38	3.45
6	3.48	3.68	3.72	4.88	5.25	9.05	9.48	6.37	4.75	4.65	4.32	3.45
7	3.50	3.60	3.75	4.75	5.30	9.28	9.20	6.20	4.73	4.85	4.20	3.55
8	3.35	3.58	3.70	4.58	5.40	9.35	8.95	6.07	4.67	5.00	4.15	3.68
9	3.38	3.58	3.75	4.50	5.38	9.15	8.82	5.93	4.63	5.05	4.15	3.75
10	3.32	3.55	3.75	4.52	5.38	8.88	8.88	5.65	4.60	4.97	4.18	3.72
11	3.35	3.55	3.80	5.20	5.60	8.55	8.65	5.53	4.55	4.87	4.05	3.68
12	3.38	3.60	3.80	5.98	6.02	8.68	8.22	5.45	4.55	4.85	3.90	3.70
13	3.40	3.60	3.78	6.12	6.55	9.25	7.85	5.33	4.55	4.85	3.72	3.65
14	3.45	3.65	3.60	6.18	6.52	9.72	8.10	5.25	4.47	4.83	3.62	3.68
15	3.48	3.65	3.65	6.35	6.25	10.00	8.22	5.30	4.50	4.77	3.70	3.45
16	3.48	3.65	3.58	6.60	6.08	10.25	7.62	5.33	4.50	4.68	3.90	3.48
17	3.45	3.65	3.65	6.60	6.15	10.30	7.30	5.30	4.53	4.60	3.88	3.45
18	3.45	3.68	3.75	6.35	6.48	10.20	7.22	5.25	4.50	4.58	3.88	3.20
19	3.40	3.62	4.35	6.05	6.88	10.22	7.15	5.17	4.43	4.58	3.88	3.25
20	3.28	3.62	5.05	5.80	7.50	10.15	7.02	5.17	4.37	4.60	3.85	3.25
21	3.18	3.65	5.48	5.52	8.25	9.95	7.00	5.20	4.37	4.60	3.80	3.32
22	3.20	3.68	5.65	5.45	8.78	9.60	7.05	5.13	4.35	4.60	3.80	3.58
23	3.32	3.72	5.65	5.45	9.12	9.55	7.00	5.03	4.35	4.55	3.62	3.68
24	3.32	3.78	5.15	5.40	9.12	9.70	6.90	4.93	4.27	4.55	3.65	3.75
25	3.40	3.75	4.95	5.40	8.82	9.82	6.98	4.87	4.27	4.55	3.62	3.78
26	3.42	3.75	5.10	5.40	8.40	9.90	7.12	4.85	4.33	4.50	3.60	3.82
27	3.50	3.78	5.15	5.32	7.90	9.95	7.12	4.85	4.55	4.50	3.68	3.92
28	3.48	3.78	4.88	5.45	7.62	9.78	7.08	4.93	4.57	4.50	3.68	3.95
29	3.40	.....	4.65	5.52	7.60	9.72	7.17	4.87	4.57	4.50	3.65	3.82
30	3.40	.....	4.38	5.68	7.55	9.75	7.00	4.87	4.50	4.48	3.60	3.78
31	3.40	.....	4.30	.....	7.55	.....	6.85	4.90	.....	4.40	.....	3.68
1908.												
1	3.8	3.3	3.75	3.95	4.65	6.35	6.5	5.1	4.5	4.1	4.4	3.8
2	3.75	3.2	3.7	4.0	4.8	6.55	6.3	5.3	4.45	4.1	4.4	3.8
3	3.8	3.35	3.7	3.9	5.1	6.7	6.15	5.4	4.3	4.1	4.4	3.9
4	3.85	3.5	3.75	3.85	5.4	7.0	6.1	5.15	4.0	4.1	4.4	4.0
5	3.85	3.3	3.8	3.7	5.4	7.4	6.1	4.95	4.0	4.1	4.2	4.15

Daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
6	3.8	3.2	3.75	3.75	5.2	7.35	6.1	4.85	3.95	4.1	4.2	4.1
7	3.75	3.25	3.7	4.0	5.25	7.2	6.0	4.85	3.95	4.1	4.1	4.0
8	3.6	3.45	3.6	4.1	5.4	7.0	5.9	4.8	3.9	4.1	4.1	4.0
9	3.6	3.4	3.6	4.15	5.7	7.1	5.8	4.75	4.0	4.1	4.05	4.0
10	3.75	3.35	3.6	4.1	5.8	7.4	5.7	4.7	4.0	4.1	4.0	3.85
11	3.8	3.4	3.7	4.3	5.7	7.95	5.65	4.65	4.0	4.15	4.0	3.9
12	3.75	3.5	3.7	4.55	5.5	8.2	5.65	5.1	4.1	4.1	4.0	3.8
13	3.8	3.55	3.8	4.75	5.4	8.1	5.6	5.3	4.1	4.0	4.1	3.9
14	3.8	3.45	3.95	5.0	5.3	7.9	5.55	5.2	4.1	4.1	4.1	3.9
15	3.9	3.45	4.0	5.2	5.3	8.0	5.6	5.1	4.2	4.1	4.1	3.9
16	3.75	3.5	4.05	5.4	5.2	8.0	5.7	5.0	4.2	4.1	4.0	4.0
17	3.75	3.5	4.2	5.4	5.45	8.0	5.7	5.0	4.2	4.2	4.0	4.0
18	3.8	3.55	4.2	5.35	5.85	7.9	5.5	4.95	4.1	4.1	4.0	3.8
19	3.8	3.5	4.3	5.4	6.1	7.4	5.35	4.9	4.1	4.15	4.1	3.7
20	3.8	3.5	4.2	5.55	6.5	6.95	5.2	4.95	4.0	4.2	4.1	3.5
21	3.9	3.6	4.1	5.65	6.75	7.1	5.1	5.1	4.0	4.3	4.2	3.5
22	4.0	3.55	4.1	5.65	6.4	7.35	5.0	5.1	4.1	4.3	4.2	3.35
23	3.95	3.55	4.0	5.75	6.25	7.6	4.9	5.1	4.1	4.3	4.1	3.45
24	4.0	3.6	4.05	5.7	6.2	7.5	4.9	5.1	4.0	4.25	4.2	3.7
25	4.0	3.6	4.1	5.5	6.4	7.4	4.9	5.05	4.0	4.15	4.15	3.8
26	3.7	3.6	4.1	5.2	6.5	7.2	4.9	4.95	4.1	4.4	4.05	3.8
27	3.4	3.6	4.2	5.0	6.4	7.1	4.9	4.9	4.2	4.4	3.9	3.8
28	3.4	3.7	4.2	4.9	6.2	7.1	4.8	4.8	4.25	4.3	3.9	3.9
29	3.45	3.7	4.15	4.9	6.05	6.9	4.8	4.75	4.1	4.3	3.85	3.9
30	3.4	.....	3.95	4.8	5.95	6.6	4.8	4.65	4.05	4.4	3.7	3.9
31	3.4	.....	3.95	.....	6.1	.....	4.8	4.6	.....	4.4	.....	3.9

NOTE.—Owing to the swiftness of the current and the discharge of warm water from the springs the gage height at this point is not affected by ice conditions.

Rating tables for Grand River at Glenwood Springs, Colo.

JANUARY 1, 1906, TO SEPTEMBER 7, 1907, AND NOVEMBER 12, 1907, TO JULY 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	480	4.20	1,400	5.40	3,050	7.20	7,260
3.10	530	4.30	1,510	5.50	3,220	7.40	7,910
3.20	580	4.40	1,630	5.60	3,400	7.60	8,620
3.30	630	4.50	1,750	5.70	3,590	7.80	9,380
3.40	690	4.60	1,870	5.80	3,790	8.00	10,210
3.50	760	4.70	2,000	5.90	4,000	8.20	11,110
3.60	830	4.80	2,140	6.00	4,210	8.40	12,090
3.70	910	4.90	2,290	6.20	4,640	8.60	13,160
3.80	990	5.00	2,440	6.40	5,090	8.80	14,350
3.90	1,080	5.10	2,590	6.60	5,580	9.00	15,660
4.00	1,180	5.20	2,740	6.80	6,110	10.00	22,600
4.10	1,290	5.30	2,890	7.00	6,670	11.00	29,900

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1900 to 1908, and is well defined.

SEPTEMBER 8 TO NOVEMBER 11, 1907, AND AUGUST 1 TO 23, 1908.

[The indirect method for shifting channels used.]

AUGUST 24, 1908, TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	415	3.80	635	4.30	1,075	4.80	1,710
3.40	445	3.90	705	4.40	1,185	4.90	1,850
3.50	485	4.00	785	4.50	1,305	5.00	2,000
3.60	525	4.10	875	4.60	1,435	5.10	2,150
3.70	575	4.20	975	4.70	1,570		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and 1909 and the form of the 1907 curve. It is fairly well defined.

Daily discharge, in second-feet, of Grand River at Glenwood Springs, Colo., for September 8 to November 11, 1907, and August 1 to 23, 1908.

Day.	1907.			Aug., 1908.	Day.	1907.			Aug., 1908.
	Sept.	Oct.	Nov.			Sept.	Oct.	Nov.	
1	.....	1,320	1,370	2,450	16	1,640	1,290	.....	2,050
2	.....	1,380	1,370	2,800	17	1,560	1,210	.....	2,050
3	.....	1,360	1,430	2,980	18	1,530	1,190	.....	2,000
4	.....	1,490	1,370	2,550	19	1,450	1,260	.....	1,950
5	.....	1,440	1,350	2,150	20	1,380	1,290	.....	2,000
6	.....	1,490	1,280	2,000	21	1,380	1,290	.....	2,150
7	.....	1,600	1,170	2,000	22	1,350	1,290	.....	2,150
8	1,850	1,790	1,220	1,930	23	1,350	1,230	.....	2,150
9	1,800	1,850	1,220	1,850	24	1,180	1,320	.....	.....
10	1,760	1,750	1,250	1,800	25	1,180	1,320	.....	.....
11	1,700	1,630	1,130	1,720	26	1,240	1,280	.....	.....
12	1,700	1,600	.....	2,270	27	1,480	1,280	.....	.....
13	1,700	1,480	.....	2,600	28	1,500	1,280	.....	.....
14	1,610	1,450	.....	2,430	29	1,500	1,370	.....	.....
15	1,640	1,380	.....	2,270	30	1,420	1,350	.....	.....
					31	.....	1,260	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Grand River at Glenwood Springs, Colo., for 1907 and 1908.

[Drainage area, 4,520 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	760	520	674	0.149	0.17	41,400	B.
February	974	704	853	.189	.20	47,400	B.
March	3,500	795	1,550	.343	.40	95,300	A.
April	5,580	1,460	3,180	.704	.79	189,000	A.
May	16,500	2,820	6,820	1.51	1.74	419,000	A.
June	24,700	7,740	18,400	4.07	4.54	1,090,000	A.
July	22,000	6,250	11,400	2.52	2.90	701,000	A.
August	5,460	2,220	3,290	.728	.84	202,000	B.
September	2,340	1,180	1,670	.370	.41	99,400	B.
October	1,850	1,230	1,400	.310	.36	86,100	B.
November	1,430	830	1,070	.237	.26	63,700	B.
December	1,130	580	839	.186	.21	51,600	C.
The year	24,700	520	4,260	.943	12.82	3,090,000	
1908.							
January	1,180	690	954	.211	.24	58,700	A.
February	910	580	745	.165	.18	42,900	A.
March	1,510	830	1,130	.250	.29	69,500	B.
April	3,690	910	2,230	.493	.55	133,000	B.
May	5,980	1,940	3,790	.838	.97	233,000	A.
June	11,100	4,980	7,880	1.74	1.94	469,000	A.
July	5,330	2,140	3,280	.726	.84	202,000	B.
August	2,980	1,440	2,080	.460	.53	128,000	C.
September	1,300	705	884	.196	.22	52,600	B.
October	1,180	785	960	.212	.24	59,000	C.
November	1,180	575	885	.196	.22	52,700	B.
December	925	430	677	.150	.17	41,600	A.
The year	11,100	430	2,120	.469	6.39	1,540,000	

NOTE.—Indirect method for shifting channel used September 8 to November 11, 1907, and August 1 to 23, 1908. Change in conditions of flow during the latter period was caused by a deposit of sediment from construction operations at the Shoshone tunnel of the Central Colorado Power Company, about 10 miles above Glenwood.

GRAND RIVER AT PALISADES, COLO.

This station, which was established April 9, 1902, to obtain information concerning the amount of water available for irrigation in Grand River Valley, is located at the steel highway bridge 2 miles above Palisades.

The station is below all important tributaries except Gunnison and Dolores rivers.

Numerous large irrigation ditches divert water above and below this station. The proposed high-line canal of the United States Reclamation Service will take its water about 7 miles above Palisades. A water-power pumping plant just above the station pumps about 80 second-feet for irrigation. There are several similar plants in that vicinity and other important plants now in course of construction.

The river usually freezes over at the highway bridge a portion of the winter, but except for the interference of slush ice and an occasional thin ice cover the winter results are good.

No change has been made in the location or datum of the chain gage on the highway bridge during the maintenance of the station.

The section at the highway bridge is permanent, but measuring conditions are not very good, especially during very high water, when the current is very swift. All measurements in 1907 and 1908 were made from a suspension bridge at Palisades, 2 miles below the gage.

Flood measurements prior to 1906 at the upper bridge are less reliable than those at the suspension bridge.

Discharge measurements of Grand River at Palisades, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 8	R. I. Meeker	255	614	12.50	1,710
April 27	do	311	1,330	14.70	5,290
June 5	W. B. Freeman	391	3,030	19.85	23,400
June 21	do	419	3,400	20.78	26,100
July 27	C. L. Chatfield	321	2,120	17.50	14,100
August 16	do	307	1,150	14.35	4,760
October 15	J. B. Stewart	268	886	13.30	2,680
November 14	do	247	547	12.39	1,360
1908.					
February 11[a]	J. B. Stewart	233	522	12.70	1,280
April 11	do	267	833	13.24	2,690
July 7	W. B. Freeman	316	1,610	15.90	7,360
August 4	do	301	1,130	14.25	4,250
September 9	S. O. Harper	254	610	12.50	1,820

[a] The river was practically free from ice at the suspension bridge. Ice 1 foot thick at gage. Gage height to bottom of ice, 11.80 feet.

Daily gage height, in feet, of Grand River at Palisades, Colo., for 1907 and 1908.

[E. N. Purdy and J. J. Morrow, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	.....	.....	12.35	12.95	14.9	17.55	20.95	16.0	13.75	13.25	13.0	12.3
2	.....	.....	12.25	12.95	14.7	17.65	20.9	15.75	13.65	13.25	13.0	12.35
3	.....	.....	12.2	13.0	14.6	18.35	20.95	15.65	13.55	13.25	13.0	12.4
4	.....	.....	12.2	13.1	14.55	19.0	20.5	15.5	13.45	13.25	12.95	12.25
5	.....	.....	12.25	13.55	14.35	19.6	20.4	15.65	13.55	13.25	12.9	12.15
6	.....	.....	12.6	13.65	14.35	19.95	20.35	15.5	13.5	13.25	12.9	12.1
7	.....	.....	12.45	13.6	14.45	20.25	20.1	15.25	13.4	14.0	12.9	12.2
8	.....	.....	12.35	13.45	14.5	20.25	19.7	15.05	13.4	13.85	12.8	12.3
9	.....	.....	12.35	13.4	14.5	20.1	19.5	14.85	13.35	13.7	12.8	12.4
10	.....	.....	12.35	13.6	14.45	19.65	19.5	14.7	13.2	13.6	12.8	12.4
11	.....	.....	12.35	14.1	14.65	19.3	19.3	14.55	13.15	13.55	12.8	12.35
12	.....	.....	12.35	15.1	15.1	19.6	18.7	14.45	13.1	13.35	12.65	12.3
13	.....	.....	12.55	15.55	15.8	19.95	18.25	14.25	13.05	13.25	12.55	12.3
14	.....	.....	12.35	15.7	15.9	20.4	18.45	14.2	13.0	13.25	12.4	12.25
15	.....	12.25	12.25	16.1	15.7	20.8	18.55	14.2	13.1	13.3	12.4	12.25
16	.....	12.2	12.35	16.35	15.45	21.0	18.0	14.2	13.3	13.25	12.45	12.15
17	.....	12.2	12.25	16.35	15.45	21.0	17.4	14.2	13.3	13.25	12.6	12.15
18	.....	12.3	12.25	16.15	15.85	21.1	17.05	14.05	13.25	13.15	12.6	12.45
19	.....	12.3	12.5	15.8	16.5	20.95	16.95	14.05	13.15	13.1	12.6	13.0
20	.....	12.25	13.3	15.45	17.45	20.85	16.75	14.0	13.1	13.1	12.6	13.2
21	.....	12.25	13.95	15.0	18.45	20.65	16.6	14.1	13.05	13.1	12.55	13.2
22	.....	12.3	14.3	14.75	19.2	20.4	16.7	14.05	13.0	13.1	12.5	13.3
23	.....	12.4	14.5	14.6	19.65	20.4	16.6	13.95	12.95	13.0	12.4	13.25
24	.....	12.45	14.0	14.65	19.8	20.4	16.45	13.75	12.9	13.0	12.3	13.2
25	.....	12.35	13.65	14.65	19.35	20.35	16.4	13.9	12.95	13.05	12.35	13.2
26	.....	12.35	13.6	14.65	18.95	20.45	17.05	14.0	13.0	13.0	12.4	13.1
27	.....	12.35	13.75	14.7	18.35	20.35	17.35	13.85	13.0	13.0	12.4	13.0
28	.....	12.45	13.65	14.75	18.15	20.4	17.3	13.8	13.05	13.0	12.5	12.8
29	.....	.....	13.45	14.95	17.85	20.6	17.15	13.75	13.1	13.0	12.45	12.7
30	.....	.....	13.2	15.0	17.65	20.75	16.6	13.7	13.1	13.0	12.5	12.6
31	.....	.....	13.05	.....	17.6	.....	16.25	13.8	.....	13.0	.....	12.8
1908.[b]												
1	12.6	12.4	12.45	12.4	13.85	15.95	16.5	13.95	13.0	12.65	12.65	12.2
2	12.6	12.3	12.35	12.45	13.9	16.5	16.25	14.35	12.85	12.6	12.65	12.25
3	12.8	12.3	12.25	12.45	14.3	16.75	16.2	14.5	12.75	12.6	12.6	12.2
4	12.8	12.4	12.35	12.4	14.65	17.1	16.1	14.15	12.7	12.6	12.55	12.3
5	12.8	12.55	12.35	12.5	14.7	17.6	16.05	13.75	12.65	12.6	12.55	12.35
6	12.8	12.55	12.45	12.55	14.55	17.85	16.0	13.6	12.6	12.6	12.6	12.35
7	12.8	12.55	12.3	12.55	14.4	17.8	15.8	13.6	12.5	12.6	12.5	12.25
8	12.8	12.5	12.2	12.75	14.5	17.4	15.6	13.5	12.5	12.6	12.55	12.15
9	12.9	12.55	12.15	12.9	14.95	17.3	15.3	13.35	12.5	12.6	12.55	12.2
10	12.65	12.55	12.2	13.05	15.3	17.95	15.0	13.3	12.6	12.55	12.55	12.15
11	12.55	12.7	12.25	13.1	15.2	18.65	15.1	13.55	12.6	12.5	12.5	12.25
12	12.4	12.6	12.2	13.4	14.95	19.2	15.05	14.0	12.55	12.5	12.45	12.2
13	12.6	12.7	12.2	13.7	14.85	19.05	15.1	14.15	12.7	12.5	12.5	12.15
14	12.8	12.6	12.3	14.05	14.7	18.75	14.9	14.3	12.6	12.5	12.45	12.2
15	12.9	12.6	12.45	14.35	14.55	18.95	14.95	14.15	12.6	12.4	12.4	12.2
16	12.8	12.6	12.6	14.75	14.5	18.9	15.0	14.0	12.6	12.6	12.35	12.45
17	12.6	12.7	12.65	14.95	14.8	18.65	15.0	13.85	12.6	12.65	12.55	12.6
18	12.5	12.7	12.75	14.8	15.35	18.65	14.75	13.8	12.6	13.6	12.35	12.25
19	12.5	12.6	12.8	14.75	15.85	18.15	14.5	14.05	12.55	13.35	12.35	12.0
20	12.55	12.6	12.75	14.9	16.35	17.4	14.25	13.95	12.5	13.1	12.35	12.05
21	12.6	12.6	12.65	15.1	16.75	17.25	14.1	14.0	12.4	12.95	12.4	12.15
22	12.75	12.6	12.65	15.3	16.45	17.2	13.95	14.0	12.4	12.75	12.45	12.4
23	12.75	12.6	12.6	15.45	16.25	18.1	13.85	13.95	12.4	12.7	12.45	12.55
24	12.75	12.5	12.55	15.35	16.2	18.0	13.75	13.85	12.4	12.7	12.5	12.95
25	12.95	12.5	12.55	15.1	16.25	17.95	13.7	13.75	12.55	12.65	12.45	13.4
26	12.8	12.4	12.5	14.7	16.35	17.75	13.65	13.6	12.6	12.65	12.4	14.05
27	12.55	12.45	12.65	14.4	16.3	17.55	13.6	13.55	12.6	12.7	12.25	14.4
28	12.55	12.4	12.8	14.15	16.1	17.7	13.6	13.45	12.6	12.7	12.2	14.65
29	12.6	12.65	12.65	14.05	15.85	17.2	13.6	13.3	12.6	12.7	12.2	14.9
30	12.55	.....	12.45	13.95	15.7	16.85	14.4	13.1	12.6	12.7	12.2	14.7
31	12.5	.....	12.4	.....	15.7	.....	13.6	13.0	12.65	12.65	.....	14.75

[a] Ice conditions December 15 to 31, 1907.
[b] Ice conditions prevailed January 1 to February 27, 1908. River frozen over December 23 to 31, 1908.

Rating table for Grand River at Palisades, Colo., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
12.00	1,170	13.30	2,730	14.60	5,040	16.80	10,780
12.10	1,260	13.40	2,890	14.70	5,250	17.00	11,450
12.20	1,350	13.50	3,050	14.80	5,460	17.20	12,140
12.30	1,450	13.60	3,210	14.90	5,680	17.40	12,860
12.40	1,550	13.70	3,380	15.00	5,900	17.60	13,600
12.50	1,650	13.80	3,550	15.20	6,350	17.80	14,360
12.60	1,760	13.90	3,720	15.40	6,810	18.00	15,150
12.70	1,880	14.00	3,900	15.60	7,290	19.00	19,400
12.80	2,000	14.10	4,080	15.80	7,780	20.00	24,200
12.90	2,130	13.20	4,260	16.00	8,310	21.00	29,600
13.00	2,270	14.30	4,450	16.20	8,880	22.00	35,500
13.10	2,420	14.40	4,640	16.40	9,490		
13.20	2,570	14.50	4,840	16.60	10,130		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1902 to 1909, and is fairly well defined above gage heights 12.2 feet. In computing many of the earlier high-water measurements too high a coefficient was used in reducing surface to mean velocities. These measurements have been revised in drawing the above curve, which is probably the best curve for the entire period, 1902 to 1909.

Monthly discharge of Grand River near Palisades, Colo., for 1907 and 1908.

[Drainage area, 8,550 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
February 15–28	1,600	1,350	1,460	0.171	0.09	40,500	B.
March	4,840	1,350	2,240	.262	.30	138,000	B.
April	9,340	2,200	5,250	.614	.68	312,000	A.
May	23,200	4,540	10,500	1.23	1.42	646,000	A.
June	30,200	13,400	24,800	2.90	3.24	1,480,000	A.
July	29,300	9,030	17,000	1.99	2.29	1,040,000	A.
August	8,310	3,380	4,890	.572	.66	301,000	A.
September	3,460	2,130	2,600	.304	.34	155,000	B.
October	3,900	2,270	2,640	.309	.36	162,000	B.
November	2,270	1,450	1,820	.213	.24	108,000	B.
December [a]	1,550	1,260	1,370	.160	.18	84,200	C.
The period						4,470,000	
January [a]			1,300	.152	.18	79,900	C.
February [a]	1,820		1,320	.154	.17	75,900	C.
March	2,000	1,350	1,630	.191	.22	100,000	B.
April	6,930	1,550	3,900	.456	.51	232,000	A.
May	10,600	3,640	6,720	.786	.91	413,000	A.
June	20,300	8,180	14,600	1.71	1.91	869,000	A.
July	9,810	3,210	5,670	.663	.76	349,000	A.
August	4,840	2,270	3,550	.415	.48	218,000	A.
September	2,270	1,550	1,760	.206	.23	105,000	B.
October	3,210	1,550	1,890	.221	.25	116,000	B.
November	1,820	1,350	1,600	.187	.21	95,200	B.
December [b]	1,760	1,170	1,320	.154	.18	81,200	B.
The year	20,300	1,170	3,770	.441	6.01	2,730,000	

[a] Discharge estimated December 21, 1907, to February 10, 1908, following approximately the rate of rise and fall at Glenwood Springs. Values for February 11 to 27 are based on the gage heights allowing for ice as noted by the observer.

[b] Discharge estimated December 21–31; maximum and minimum are for December 1 to 20.

NORTH INLET TO GRAND LAKE AT GRAND LAKE, COLO.

Two streams, known as the North and East inlets, flow into Grand Lake, North Inlet being the larger.

The gaging station on the North Inlet, which was established August 3, 1905, to obtain information concerning the run-off from a high mountainous area and also for use in connection with power development, is located at the footbridge which crosses the stream about 100 yards north of the mouth and 300 yards east of the Grand Lake postoffice.

The approximate elevation of this basin is 8,000 to 11,000 feet above sea-level, and the fall of the stream is very great.

No important tributaries enter above the station, which therefore gives results for the whole drainage area, measuring 36.5 square miles.

No water is diverted above the station. but filings have already been made for power development.

The stream is frozen over with thick ice for about four months. Gage readings during this period are therefore of little value.

No change has been made in the datum of the staff gage at the bridge during the maintenance of the station.

The accuracy of the records is affected by the roughness of the stream bed and by ice conditions. The records are fragmentary as the gage has not been read continuously.

Discharge measurements of North Inlet to Grand Lake at Grand Lake, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 24	C. L. Chatfield	60	140	3.78	488
July 22	do	56	106	3.13	284
August 12	do	52	63	2.53	109
October 2	Freeman and Stewart	44	35.8	2.06	21.2
November 26[a]	J. B. Stewart	6	4	4.32	3.3
1908.					
January 30[a]	J. B. Stewart	4	2.8	.....	6.5
February 26[a]	do	5	2.1	.....	3.1
May 20	C. L. Chatfield	49	79	2.80	151
June 11	do	52	94	3.00	204
July 3	Hoyt and Freeman	51	90	2.88	174
July 27	C. L. Chatfield	49	60	2.42	68
August 18	do	46	64	2.50	84
September 17	do	47	42	2.12	27
October 22	do	45	38	2.00	14
November 23[a]	do	7	5.2	2.40	7.7
December 21[a]	do	7	4	.....	6

[a] Ice conditions. Measurements by wading.

NOTE.—Discharge measurements made at this station in 1905 and 1906 are published in Water-Supply Papers 175, p. 75, and 211, p. 67, respectively.

Daily gage height, in feet, of North Inlet to Grand Lake at Grand Lake, Colo., for 1907 and 1908.

[J. Cairns and B. V. Glick, observers.]

Day.	Mar.	Apr.	July.	Aug.	Oct.	Day.	Mar.	Apr.	July.	Aug.	Oct.
1907.						1908.					
1		2.2			2.01	1					
2		2.3			2.01	2					
3		2.4			2.01	3			2.85		
4		2.4			2.01	4			2.95		
5		2.4		2.73	2.01	5			3.0		
6		2.4		2.73	2.02	6			2.95		
7		2.4		2.68	2.02	7			2.95		
8		2.4		2.63	2.02	8			2.85		
9		2.5		2.63	2.01	9			2.85		
10		2.5		2.63	2.01	10			2.8		
11		2.5		2.58	2.01	11			2.8		
12		2.5		2.53	2.01	12			2.8		
13		2.5		2.50	2.01	13			2.8		
14		2.55		2.50	2.01	14			2.85		
15		2.55		2.50	2.01	15			2.85		
16		2.6		2.45	2.01	16			2.8		
17	2.2	2.5		2.45	2.01	17			2.7		
18	2.25	2.45		2.40	2.01	18			2.6		
19	2.25	2.45		2.40	2.01	19			2.6		
20	2.25	2.45		2.40	2.01	20			2.55		
21	2.25	2.45		2.40	2.00	21			2.55		
22	2.25	2.45		2.35	2.00	22			2.5		
23	2.2	2.4		2.35	2.00	23					
24	2.3	2.35		2.30	2.00	24					
25	2.35	2.35		2.35	2.00	25					
26	2.3	2.4		2.35	2.00	26					
27	2.25	2.4		2.35	2.00	27			2.42		
28	2.2	2.3		2.30	2.00	28					
29	2.2	2.3		2.30	2.00	29					
30	2.2	2.25		2.30	2.00	30					
31	2.2				2.00	31					

Rating tables for North Inlet to Grand Lake at Grand Lake, Colo.

1905 TO 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	7	2.60	125	3.40	377
1.90	11	2.70	150	3.50	417
2.00	17	2.80	177	3.60	459
2.10	27	2.90	206	3.70	503
2.20	42	3.00	237	3.80	548
2.30	60	3.10	269	3.90	595
2.40	80	3.20	303	4.00	644
2.50	102	3.30	339		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905 to 1907, and 1908, and is fairly well defined above gage height 2.0 feet.

1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	65	2.70	127	2.90	178
2.50	84	2.80	152	3.00	205
2.60	104				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and is well defined.

Monthly discharge of North Inlet to Grand Lake at Grand Lake, Colo., for 1905 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
August	60	17	33.9	2,080	D.
September	17	7	10.7	637	D.
October	14	7	8.2	504	D.
November	11	9	10.7	637	D.
December	11	7	7.6	467	D.
The period				4,320	
1906.					
May 3–31	321	51	194	11,200	B.
June	644	200	351	20,900	B.
July 1–22	317	155	259	11,300	B.
1907.					
March 17–31	70	42	49.9	1,480	B.
April	125	42	85.1	5,060	B.
August 5–30	158	60	95.5	4,920	A.
October	19	17	17.7	1,090	B.
December			4.0	246	D.
1908.					
January			5.5	338	D.
February			4.0	230	D.
July 3–27	205	69	134	6,640	A.

NOTE.—Ice conditions during December, 1907, January and February, 1908, and discharge estimated.

GRAND LAKE OUTLET AT GRAND LAKE, COLO.

This station, which was established July 31, 1904, is located at the west end of Grand Lake, about one-half mile south of Grand Lake post-office. Granby, about 15 miles distant, on the Denver, Northwestern and Pacific Railroad, is the nearest railroad point.

The records of the station show the storage possibilities of Grand Lake and the total run-off from the North and East inlets, and are valuable for use in connection with power development. The drainage area at the station is 62 square miles.

Shore ice forms at the station for about four months, but the stream does not freeze over because of the higher temperature of the water coming out of Grand Lake.

The location and datum of the staff gage have remained unchanged during the maintenance of the station.

During low stages, the rough bottom and sluggish character of the stream affect the accuracy of the results to a considerable extent.

Measurements have been made at various sections, but usually at a ford one-fourth mile downstream from the footbridge where the gage is located. There is a tag wire across the stream at the ford.

Discharge measurements of Grand Lake Outlet at Grand Lake, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	C. L. Chatfield	196	389	3.95	938
July 21	do	147	246	3.25	534
August 12	do	123	138	2.40	179
October 2	Freeman and Stewart	100	79	1.70	45
November 26	J. B. Stewart	28	14	1.35	5
1908.					
January 30	J. B. Stewart	28	12	1.30	7
February 26	do	14	12	1.25	6
May 20	C. L. Chatfield	125	147	2.68	240
June 11	do	125	187	3.05	389
July 3	Hoyt and Freeman	125	171	2.80	314
July 27	C. L. Chatfield	123	114	2.20	127
August 17	do	125	122	2.35	144
September 17	do	40	28	1.80	43
October 22	do	36	21	1.58	20
November 23	do	12	5.6	1.40	13.2
December 21	do	10	9.4	1.40	13

NOTE.—The above measurements were made by wading at various sections.

Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1907 and 1908.

[Mrs. Myrtle Westcott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	1.40	1.30	1.30	1.55	1.70	2.30	4.15	2.82	1.95	1.72	1.55	1.20
2	1.40	1.35	1.30	1.55	1.70	2.42	4.18	2.70	1.95	1.70	1.50	1.20
3	1.40	1.40	1.35	1.55	1.70	2.68	4.15	2.65	1.92	1.70	1.50	1.20
4	1.38	1.42	1.35	1.58	1.65	2.72	4.00	2.78	1.90	1.65	1.50	1.20
5	1.35	1.42	1.32	1.60	1.65	2.88	4.15	2.85	1.85	1.68	1.45	1.15
6	1.35	1.40	1.30	1.65	1.70	3.22	4.12	2.70	1.85	1.68	1.45	1.15
7	1.35	1.40	1.32	1.62	1.70	3.15	4.02	2.60	1.85	1.80	1.45	1.15
8	1.35	1.40	1.35	1.62	1.70	3.08	4.05	2.55	1.82	1.82	1.45	1.15
9	1.35	1.40	1.35	1.62	1.70	3.00	3.95	2.50	1.80	1.88	1.45	1.15
10	1.35	1.40	1.35	1.65	1.70	2.88	3.82	2.48	1.80	1.88	1.45	1.15
11	1.35	1.40	1.35	1.72	1.78	2.88	3.68	2.45	1.78	1.85	1.45	1.15
12	1.35	1.40	1.38	1.80	1.88	3.15	3.52	2.38	1.75	1.82	1.40	1.15
13	1.35	1.40	1.40	1.82	1.95	3.42	3.48	2.32	1.72	1.88	1.40	1.15
14	1.35	1.38	1.40	1.90	1.95	3.68	3.62	2.28	1.70	1.82	1.40	1.15
15	1.35	1.40	1.40	1.95	1.95	3.78	3.52	2.25	1.70	1.80	1.35	1.15
16	1.35	1.35	1.38	2.00	1.95	3.88	3.30	2.25	1.75	1.72	1.35	1.15
17	1.30	1.35	1.40	2.00	1.95	3.82	3.20	2.25	1.70	1.72	1.35	1.15
18	1.30	1.35	1.35	1.95	2.02	3.95	3.18	2.20	1.70	1.68	1.35	1.15
19	1.30	1.35	1.35	1.90	2.22	4.15	3.10	2.15	1.65	1.68	1.35	1.15
20	1.30	1.35	1.42	1.85	2.50	3.95	3.15	2.15	1.65	1.65	1.32	1.15
21	1.30	1.35	1.45	1.80	2.80	3.85	3.22	2.15	1.65	1.62	1.30	1.15
22	1.30	1.32	1.48	1.80	3.08	3.70	3.20	2.10	1.65	1.62	1.30	1.15
23	1.30	1.30	1.50	1.78	3.08	3.90	3.22	2.08	1.65	1.62	1.30	1.15
24	1.30	1.30	1.50	1.75	3.02	3.98	3.05	2.05	1.65	1.62	1.30	1.15
25	1.30	1.30	1.55	1.75	2.90	4.15	3.05	2.05	1.68	1.55	1.25	1.20
26	1.30	1.30	1.60	1.75	2.70	4.15	3.18	2.05	1.68	1.55	1.25	1.20
27	1.30	1.30	1.60	1.75	2.55	3.98	3.62	2.05	1.68	1.55	1.25	1.20
28	1.30	1.30	1.65	1.75	2.45	3.98	3.58	2.05	1.72	1.58	1.25	1.20
29	1.30	.....	1.65	1.75	2.38	3.90	3.28	2.05	1.65	1.58	1.25	1.20
30	1.30	.....	1.60	1.75	2.35	4.12	3.05	2.00	1.68	1.55	1.22	1.20
31	1.30	.....	1.55	.....	2.28	.....	2.90	1.95	.....	1.55	.....	1.25
1908.[a]												
1	1.25	1.3	1.25	1.3	1.8	2.45	2.9	2.75	2.0	1.7	1.5	1.35
2	1.25	1.3	1.25	1.3	1.75	2.5	2.8	2.6	1.95	1.65	1.5	1.35
3	1.25	1.3	1.25	1.25	1.85	2.6	2.8	2.5	1.95	1.65	1.5	1.35
4	1.25	1.3	1.25	1.25	1.95	2.9	2.8	2.4	1.9	1.65	1.5	1.35
5	1.3	1.3	1.25	1.25	1.95	3.05	2.85	2.3	1.9	1.65	1.45	1.35

[a] Gage heights practically unaffected by ice conditions, 1907 and 1908.

Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
6	1.3	1.3	1.25	1.25	1.9	3.0	2.8	2.25	1.85	1.65	1.45	1.35
7	1.3	1.3	1.25	1.25	1.95	2.9	2.8	2.2	1.8	1.65	1.45	1.35
8	1.3	1.3	1.25	1.3	2.0	2.8	2.8	2.2	1.8	1.65	1.45	1.35
9	1.25	1.3	1.25	1.3	2.2	2.7	2.8	2.15	1.8	1.65	1.45	1.35
10	1.25	1.3	1.25	1.35	2.2	2.9	2.8	2.1	1.8	1.65	1.45	1.35
11	1.25	1.3	1.25	1.4	2.1	3.1	2.75	2.3	1.85	1.6	1.45	1.35
12	1.25	1.3	1.25	1.4	2.1	3.4	2.75	2.65	1.8	1.6	1.45	1.35
13	1.25	1.25	1.25	1.5	2.0	3.25	2.75	2.65	1.8	1.6	1.4	1.35
14	1.25	1.25	1.25	1.6	2.0	3.2	2.7	2.6	1.85	1.55	1.4	1.35
15	1.25	1.25	1.25	1.7	1.95	3.35	2.7	2.5	1.85	1.55	1.4	1.35
16	1.3	1.25	1.25	1.9	1.95	3.4	2.65	2.4	1.8	1.55	1.4	1.35
17	1.3	1.25	1.25	2.0	2.1	3.5	2.6	2.4	1.8	1.55	1.4	1.4
18	1.3	1.25	1.25	2.05	2.25	3.4	2.5	2.3	1.8	1.55	1.4	1.4
19	1.25	1.25	1.25	2.1	2.4	3.0	2.45	2.3	1.75	1.55	1.4	1.4
20	1.25	1.25	1.3	2.1	2.7	2.95	2.4	2.35	1.75	1.55	1.4	1.4
21	1.3	1.25	1.3	2.1	2.7	3.25	2.3	2.5	1.75	1.55	1.4	1.4
22	1.3	1.25	1.25	2.15	2.55	3.55	2.3	2.7	1.7	1.55	1.4	1.4
23	1.3	1.25	1.25	2.2	2.4	3.6	2.25	2.8	1.7	1.55	1.4	1.4
24	1.3	1.25	1.25	2.15	2.3	3.4	2.3	2.6	1.7	1.55	1.4	1.4
25	1.3	1.25	1.25	2.1	2.4	3.3	2.25	2.5	1.65	1.55	1.4	1.4
26	1.3	1.25	1.25	2.0	2.4	3.3	2.25	2.4	1.65	1.55	1.4	1.4
27	1.3	1.25	1.25	2.0	2.3	3.3	2.2	2.4	1.65	1.5	1.35	1.4
28	1.3	1.25	1.25	1.9	2.3	3.1	2.2	2.2	1.65	1.5	1.35	1.4
29	1.3	1.25	1.3	1.85	2.2	3.0	2.2	2.15	1.7	1.5	1.35	1.4
30	1.3	.....	1.3	1.8	2.25	2.9	2.6	2.1	1.7	1.5	1.35	1.4
31	1.3	.....	1.3	.....	2.35	.....	2.9	2.1	.....	1.5	.....	1.4

[a] Gage heights practically unaffected by ice conditions, 1907 and 1908.

Rating tables for Grand Lake Outlet at Grand Lake, Colo.

1906 AND 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.15	3	2.00	84	2.90	379	3.80	835
1.20	4	2.10	106	3.00	420	3.90	890
1.30	7	2.20	131	3.10	465	4.00	945
1.40	11	2.30	159	3.20	515	4.10	1,000
1.50	16	2.40	190	3.30	565	4.20	1,055
1.60	23	2.50	224	3.40	615	4.30	1,110
1.70	33	2.60	260	3.50	670		
1.80	47	2.70	298	3.60	725		
1.90	64	2.80	338	3.70	780		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on ten discharge measurements made during 1906 and 1907, and is well defined.

JANUARY 1 TO OCTOBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	4.5	1.90	60	2.60	230	3.30	502
1.30	7.5	2.00	77	2.70	263	3.40	550
1.40	11	2.10	97	2.80	297	3.50	600
1.50	16	2.20	119	2.90	333	3.60	656
1.60	22	2.30	143	3.00	372		
1.70	32	2.40	170	3.10	413		
1.80	44	2.50	199	3.20	456		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1908 and form of preceding curves. It is well defined between gage height 1.25 feet and 3.05 feet.

Rating tables for Grand Lake Outlet at Grand Lake, Colo.—Continued.

NOVEMBER 1 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.35	11	1.45	15
1.40	13	1.50	18

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements and form of preceding curve.

Monthly discharge of Grand Lake Outlet at Grand Lake, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	11	7	8.3	510	D.
February	12	7	9.4	522	D.
March	28	7	13.3	818	D.
April	84	20	42.9	2,550	C.
May	456	28	147	9,040	A.
June	1,030	159	685	40,800	A.
July	1,040	379	698	42,900	A.
August	358	74	175	10,800	A.
September	74	28	41.3	2,460	C.
October	61	20	34.9	2,150	C.
November	20	4.6	10.4	619	D.
December	5.5	3.0	3.4	209	D.
The year	1,040	3	156	113,000	
1908.					
January	7.5	6	6.87	422	B.
February	7.5	6	6.62	381	B.
March	7.5	6	6.24	384	C.
April	119	6	47.3	2,810	B.
May	263	38	119	7,320	A.
June	656	184	424	25,200	A.
July	333	119	231	14,200	A.
August	297	97	174	10,700	A.
September	77	27	44.0	2,620	B.
October	32	16	21.5	1,320	B.
November	18	11	13.9	827	B.
December	13	11	12.0	738	B.
The year	656	6	92.2	66,900	

FRASER RIVER AT GRANBY, COLO.

Fraser River rises among the peaks of the Front Range in southeastern Grand County and flows in a generally northwesterly direction to its junction with Grand River in the east-central part of Middle Park.

The gaging station, which was established July 28, 1904, to obtain data for use in determining the availability of the stream for power, storage, and irrigation, is located at the wagon bridge three-quarters of a mile southwest of Granby, about 4 miles above the mouth of Fraser River, in sec. 9, T. 1 N., R. 76 W., and is below all tributaries.

The drainage area is about 220 square miles.

Other than small irrigation ditches, there are no important diversions above the station. A small canal is taken out a few feet downstream from the measuring section. It is proposed to divert water by means of a tunnel from the headwaters of this river into the headwaters of South Boulder Creek, in the Platte drainage basin.

Thick ice covers the stream for about four months of the year; anchor ice also occurs. Each year in the low season a small temporary diversion dam is generally constructed about 50 feet below the station to divert the water into the canal below. This dam backs the water up on the gage, thus affecting the conditions of free flow.

Neither the location nor the datum of the staff gage at the highway bridge has been changed during the maintenance of the station.

Measuring conditions are rather poor. During high stages the measurements are affected by backwater and a boiling effect caused by the crib piers of the bridge. During low stages ice conditions and the temporary diversion dam interfere with good results.

Discharge measurements of Fraser River at Granby, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	C. L. Chatfield	55	110	5.05	242
June 22	do	59	197	6.35	1,000
July 19	do	60	148	5.42	431
August 11	do	56	116	4.90	188
October 11	Freeman and Stewart	53.5	93	4.64	97
November 25[a]	J. B. Stewart	80	34	4.65	42
1908.					
January 27[a]	J. B. Stewart	41	33	[b] 5.48	45
February 28[a]	do	9	18	[c] 4.80	37
May 19	C. L. Chatfield	58	131	5.20	284
June 12	do	59	178	5.80	677
July 2	Hoyt and Freeman	58	139	5.32	328
July 26	C. L. Chatfield	65	112	4.90	165
August 15	do	42	88	4.90	121
September 16	do	39	80	4.60	78
October 20	do	38	73	4.50	46
November 22[a]	do	40	56	4.70	57
December 22[d]	do	23	25	.....	48

[a] Ice conditions.
[b] To water surface; to top of ice, 6.18; thickness of ice, 3.10.
[c] To water surface; to top of ice, 6.20; thickness of ice, 3.10.
[d] Measured below pumping station opposite Granby; river partly frozen.

NOTE.—These measurements were made at various sections.

Daily gage height, in feet, of Fraser River at Granby, Colo., for 1907 and 1908.

[J. N. Ostrander, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	.....	.....	.....	4.65	4.9	5.7	6.45	5.1	4.7	4.5	4.5	.....
2	.....	.....	.....	4.7	4.85	5.75	6.4	5.05	4.7	4.5	4.4	.....
3	.....	.....	.....	4.65	4.85	5.85	6.4	5.0	4.7	4.5	4.4	.....
4	.....	.....	.....	4.65	4.8	5.95	6.3	5.25	4.7	4.5	4.4	.....
5	.....	.....	.....	4.6	4.8	6.15	6.2	5.15	4.7	4.5	4.4	.....
6	.....	.....	.....	4.6	4.8	6.35	6.15	5.05	4.7	4.5	4.3	.....
7	.....	.....	.....	4.6	4.9	6.4	6.1	5.0	4.7	4.5	4.3	.....
8	.....	.....	.....	4.65	4.95	6.25	6.05	5.0	4.7	4.5	4.3	.....
9	.....	.....	.....	4.7	4.95	6.2	6.0	4.9	4.7	4.5	4.3	.....
10	.....	.....	.....	5.0	4.95	6.0	5.95	4.8	4.7	4.5	4.3	.....
11	.....	.....	.....	5.25	5.0	6.05	5.9	4.8	4.7	4.5	4.3	.....
12	.....	.....	.....	5.1	5.3	6.3	5.8	4.85	4.6	4.5	4.3	.....
13	.....	.....	.....	5.1	5.3	6.4	5.9	4.8	4.6	4.5	4.3	.....
14	.....	.....	.....	5.15	5.3	6.6	6.0	4.8	4.6	4.5	4.3	.....
15	.....	.....	.....	5.15	5.2	6.7	5.85	4.8	4.6	4.5	4.25	.....
16	.....	.....	.....	5.15	5.25	6.75	5.65	4.8	4.6	4.5	.....	.....
17	.....	.....	4.4	5.05	5.25	6.6	5.6	4.8	4.6	4.5	.....	.....
18	.....	.....	4.4	5.0	5.3	6.65	5.6	4.8	4.6	4.5	.....	.....
19	.....	.....	4.5	4.9	5.55	6.7	5.5	4.8	4.6	4.5	.....	.....
20	.....	.....	4.65	4.9	5.7	6.55	5.35	4.8	4.6	4.5	.....	.....
21	.....	.....	4.7	4.95	6.05	6.5	5.25	4.8	4.6	4.5	.....	.....
22	.....	.....	4.7	5.0	6.25	6.35	5.2	4.8	4.6	4.5	.....	.....
23	.....	.....	4.7	5.05	6.3	6.5	5.1	4.8	4.5	4.5	.....	.....
24	.....	.....	4.7	4.9	6.3	6.5	5.1	4.8	4.5	4.5	.....	.....
25	.....	.....	4.65	4.9	6.05	6.5	5.05	4.75	4.5	4.5	.....	.....
26	.....	.....	4.6	4.9	5.8	6.5	5.2	4.7	4.5	4.5	.....	.....
27	.....	.....	4.6	4.9	5.8	6.45	5.4	4.7	4.5	4.5	.....	.....
28	.....	.....	4.6	4.9	5.75	6.45	5.35	4.8	4.5	4.5	.....	.....
29	.....	.....	4.5	4.95	5.75	6.35	5.35	4.8	4.5	4.5	.....	.....
30	.....	.....	4.5	4.95	5.7	6.5	5.2	4.8	4.5	4.5	.....	.....
31	.....	.....	4.55	.....	5.8	.....	5.15	4.7	.....	4.5	.....	.....
1908.[b]												
1	5.5	.....	.....	4.5	4.6	5.3	5.4	5.3	4.7	4.6	4.5	4.95
2	5.5	.....	.....	4.5	4.6	5.4	5.4	5.15	4.7	4.6	4.5	5.0
3	5.5	.....	.....	4.5	4.6	5.5	5.4	5.1	4.7	4.6	4.5	5.1
4	5.5	.....	.....	4.5	4.65	5.5	5.35	5.0	4.6	4.6	4.5	5.1
5	5.5	.....	.....	4.5	4.7	5.5	5.3	4.9	4.6	4.6	4.55	5.1
6	5.4	.....	.....	4.5	4.7	5.6	5.3	5.1	4.6	4.6	4.55	5.15
7	5.4	.....	.....	4.6	4.8	5.6	5.2	5.15	4.55	4.6	4.55	5.15
8	5.4	.....	.....	4.6	4.9	5.6	5.15	5.0	4.55	4.6	4.55	5.25
9	5.4	.....	.....	4.6	4.9	5.6	5.1	4.9	4.5	4.6	4.55	5.25
10	5.4	.....	.....	4.6	4.85	5.7	5.1	4.9	4.6	4.6	4.55	5.25
11	5.5	.....	.....	4.7	4.8	5.9	5.1	4.95	4.6	4.6	4.55	5.25
12	5.5	.....	.....	4.7	4.8	6.0	5.05	5.15	4.6	4.6	4.5	5.4
13	5.5	.....	.....	4.7	4.8	6.1	5.0	5.2	4.6	4.6	4.5	5.25
14	5.5	.....	.....	4.7	4.8	6.1	5.0	5.2	4.55	4.6	4.5	5.3
15	5.5	.....	.....	4.7	4.8	6.0	5.0	4.9	4.5	4.6	4.5	5.1
16	5.5	.....	.....	4.7	4.8	5.85	5.0	4.9	4.5	4.6	4.5	5.1
17	5.5	.....	.....	4.7	4.9	5.8	5.0	4.9	4.5	4.6	4.5	5.1
18	5.5	.....	.....	4.7	4.95	5.75	5.0	5.0	4.5	4.6	4.5	5.3
19	5.5	.....	.....	4.7	5.1	5.6	5.0	5.1	4.5	4.6	4.5	5.4
20	5.5	.....	.....	4.7	5.2	5.6	5.0	5.1	4.45	4.6	4.5	5.45
21	5.5	.....	.....	4.7	5.1	5.6	5.0	5.1	4.45	4.5	4.5	5.5
22	5.5	.....	.....	4.7	5.2	5.6	5.0	5.0	4.4	4.5	4.7	5.35
23	5.5	.....	.....	4.7	5.2	5.7	4.9	5.0	4.4	4.55	4.7	5.3
24	5.5	.....	.....	4.7	5.3	5.6	4.95	5.0	4.4	4.55	4.8	5.3
25	5.5	.....	.....	4.7	5.3	5.6	5.0	4.9	4.4	4.5	4.8	5.4
26	.....	.....	.....	4.6	5.3	5.6	4.9	4.85	4.45	4.55	4.8	5.45
27	.....	.....	.....	4.6	5.2	5.6	4.85	4.8	4.5	4.55	4.8	5.55
28	.....	.....	.....	4.6	5.2	5.6	5.2	4.8	4.5	4.6	4.9	5.6
29	.....	.....	.....	4.6	5.2	5.5	5.25	4.8	4.6	4.55	4.9	5.6
30	.....	.....	.....	4.6	5.2	5.5	5.45	4.8	4.6	4.55	5.1	5.6
31	.....	.....	.....	.....	5.2	.....	5.45	4.8	.....	4.55	.....	5.6

[a] Ice condition November 16 to December 31, 1907.
[b] Ice conditions January 1 to March 31, 1908, and November 22 to December 31, 1908. Beginning July 24, 1908, conditions of flow affected by changes made in diversion weir below station.

Rating tables for Fraser River at Granby, Colo.

MARCH 17 TO JUNE 14, AND JULY 6 TO NOVEMBER 15, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.25	45	4.90	180	5.60	570	6.30	1,210
4.30	50	5.00	220	5.70	650	6.40	1,310
4.40	60	5.10	260	5.80	730	6.50	1,420
4.50	80	5.20	310	5.90	820	6.60	1,530
4.60	100	5.30	370	6.00	910		
4.70	120	5.40	430	6.10	1,000		
4.80	150	5.50	500	6.20	1,100		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1907 and form of the 1905 curve. It is well defined except at low stages.

JUNE 15 TO JULY 5, 1907.

[Indirect method for shifting channels used.]

APRIL 1 TO JULY 23, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.50	66	5.00	197	5.50	455	6.00	854
4.60	83	5.10	235	4.60	524	6.10	950
4.70	105	5.20	280	5.70	598		
4.80	132	5.30	332	5.80	677		
4.90	163	5.40	391	5.90	763		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on four discharge measurements made during 1908 and the form of the 1907 curve. It is well defined between gage heights 4.9 feet and 6.1 feet.

JULY 24 TO NOVEMBER 21, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Fraser River at Granby, Colo., for June 15 to July 5, 1907.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		1,280	11			21	1,190	
2		1,240	12			22	1,050	
3		1,260	13			23	1,180	
4		1,170	14			24	1,190	
5		1,090	15	1,610		25	1,210	
6			16	1,630		26	1,230	
7			17	1,440		27	1,200	
8			18	1,450		28	1,210	
9			19	1,470		29	1,130	
10			20	1,280		30	1,300	
						31		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Daily discharge, in second-feet, of Fraser River at Granby, Colo., for July 24 to November 21, 1908.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1		160	86	70	46	16		122	60	56	46
2		120	86	70	46	17		122	60	56	46
3		110	86	70	46	18		153	60	56	46
4		87	70	70	46	19		186	60	56	46
5		80	70	64	50	20		190	53	51	46
6		110	70	64	50	21		190	53	46	46
7		120	62	64	50	22		157	50	46	
8		87	62	64	50	23		157	50	50	
9		70	60	64	50	24	190	160	50	50	
10		70	75	64	50	25	200	129	50	46	
11		80	75	64	50	26	165	115	52	50	
12		20	75	64	46	27	150	104	58	50	
13		140	78	56	46	28	140	107	58	55	
14		140	68	56	46	29	150	107	70	50	
15		120	61	56	46	30	210	107	70	50	
						31	210	107		50	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Fraser River at Granby, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 17-31	120	60	96.7	2,880	C.
April	340	100	190	11,300	B.
May	1,210	150	494	30,400	A.
June	1,610	650	1,180	70,200	B.
July	1,280	240	680	41,800	A.
August	340	120	175	10,800	B.
September	120	80	102	6,070	B.
October	80	80	80.0	4,920	C.
November	80		49.7	2,960	D.
December			45.0	2,770	D.
The period				184,000	
1908.					
January			45.0	2,770	D.
February			37.6	2,160	D.
March			45.1	2,770	D.
April	105	66	90.6	5,390	C.
May	332	83	194	11,900	A.
June	950	332	580	34,500	A.
July	391	140	232	14,300	B.
August	190	70	123	7,560	C.
September	86	50	64.6	3,840	D.
October	70	46	57.4	3,530	D.
November			49.6	2,950	D.
December			52.3	3,210	D.
The year			131	95,000	

NOTE.—Ice conditions and discharge estimated for periods November 15 to December 31, 1907; January 1 to March 31, and November 22 to December 31, 1908. Discharge obtained by shifting-channel methods for June 15 to July 5, 1907, and July 24 to November 21, 1908.

WILLIAMS FORK NEAR SULPHUR SPRINGS, COLO.

Williams Fork rises in the Williams River Mountains and flows northwestward, joining Grand River in the central part of Middle Park.

The gaging station was established July 25, 1904, to obtain data for use in connection with the development of the stream for power, storage, and irrigation. It is located near the mouth of the stream, at the wagon bridge on the ranch of F. A. Field, about 9 miles west of Hot Sulphur Springs, Colo. The nearest railroad point is Parshall, a station on the Denver, Northwestern and Pacific Railroad.

The drainage area is about 200 square miles.

The station is below all tributaries. A number of irrigation ditches divert water above the station, and it is possible that in the future a tunnel will divert water from the headwaters of Williams Fork to the headwaters of Clear Creek in the Platte drainage basin. Some work has been done toward the construction of a reservoir and power plant a couple of miles downstream from the station.

Springs keep the ice from getting very thick at this station, but slush ice occurs frequently throughout the winter.

No change has been made in the location or in the datum of the staff gage at the bridge during the maintenance of the station.

Results are satisfactory. During low stages in the winter, the flow is constant, being nearly all from springs.

Discharge measurements of Williams Fork near Sulphur Springs, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 20[a]	R. I. Meeker	26	44	3.17	45
April 26	C. L. Chatfield	45	71	3.45	92
May 28	W. B. Freeman	50	106	4.08	342
June 21	C. L. Chatfield	64	154	4.70	860
July 18	do	51	112	4.15	373
August 10	do	48	80	3.65	144
September 30	Freeman and Stewart	45	67	3.42	75
November 24	J. B. Stewart	42	55	3.09	42
1908.					
January 24[b]	J. B. Stewart	34	47	3.12	40
February 29[b]	do	28	44	3.10	40
March 18[c]	C. L. Chatfield	38	37	3.19	51
April 17	do	47	79	3.65	131
May 22	do	49	94	3.92	230
June 14	do	54	131	4.50	614
July 4	Hoyt and Freeman	52	97	4.07	269
July 25	C. L. Chatfield	48	80	3.68	133
August 14	do	45	70	3.49	91
September 15	do	45	67	3.37	65
October 24	do	45	63	3.33	69
November 21	do	27	44	3.20	58
December 23[d]	do	24	31	4.60	51

[a] Fringe of ice along banks.
[b] Ice along edges. Right channel frozen solid, ice 1.7 feet thick.
[c] Wading measurement.
[d] Measurement through ice.

Daily gage height, in feet, of Williams Fork near Sulphur Springs, Colo., for 1907 and 1908.

[F. A. Field, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	3.25	3.14	3.15	3.33	3.55	4.04	4.99	3.88	3.48	3.44	3.30	3.21
2	3.20	3.14	3.18	3.33	3.52	4.19	4.92	3.86	3.48	3.44	3.30	3.18
3	3.20	3.14	3.18	3.40	3.54	4.28	4.82	3.82	3.45	3.43	3.30	3.30
4	3.18	3.14	3.18	3.44	3.51	4.22	4.78	3.88	3.45	3.42	3.30	3.28
5	3.22	3.13	3.18	3.40	3.50	4.22	4.78	3.82	3.45	3.41	3.30	3.25
6	3.20	3.12	3.19	3.40	3.55	4.28	4.72	3.82	3.42	3.42	3.30	3.08
7	3.21	3.12	3.17	3.36	3.58	4.42	4.68	3.79	3.44	3.49	3.26	3.13
8	3.20	3.14	3.14	3.35	3.58	4.38	4.64	3.81	3.35	3.46	3.28	3.14
9	3.18	3.12	3.14	3.40	3.57	4.40	4.56	3.80	3.35	3.42	3.26	3.14
10	3.18	3.12	3.16	3.54	3.56	4.35	4.58	3.72	3.31	3.40	3.21	3.18
11	3.19	3.12	3.18	3.70	3.68	4.35	4.47	3.62	3.30	3.40	3.19	3.11
12	3.19	3.12	3.16	3.60	3.78	4.50	4.45	3.64	3.30	3.38	3.10	3.11
13	3.18	3.14	3.18	3.68	3.79	4.62	4.40	3.62	3.31	3.37	3.00	3.16
14	3.19	3.14	3.15	3.74	3.74	4.72	4.44	3.62	3.30	3.36	3.02	3.14
15	3.20	3.14	3.15	3.78	3.72	4.80	4.35	3.60	3.30	3.36	3.02	3.18
16	3.15	3.15	3.20	3.84	3.70	4.87	4.32	3.70	3.30	3.35	3.22	3.20
17	3.18	3.15	3.22	3.74	3.76	4.81	4.26	3.65	3.30	3.35	3.12	3.22
18	3.18	3.15	3.57	3.64	3.78	4.80	4.22	3.60	3.30	3.32	3.22	3.22
19	3.16	3.16	3.92	3.60	3.91	4.88	4.18	3.61	3.30	3.32	3.15	3.20
20	3.18	3.16	3.71	3.52	4.05	4.75	4.14	3.61	3.30	3.33	3.00	3.20
21	3.15	3.16	3.74	3.38	4.24	4.72	4.11	3.65	3.30	3.34	3.12	3.22
22	3.15	3.18	3.57	3.55	4.28	4.72	4.08	3.61	3.30	3.36	3.12	3.22
23	3.18	3.18	3.48	3.54	4.32	4.80	4.03	3.56	3.30	3.36	3.10	3.20
24	3.14	3.19	3.44	3.60	4.35	4.81	4.06	3.60	3.30	3.37	3.14	3.20
25	3.12	3.17	3.49	3.58	4.26	4.86	4.12	3.54	3.30	3.34	3.13	3.16
26	3.12	3.17	3.49	3.56	4.18	4.89	4.18	3.59	3.40	3.32	3.14	3.16
27	3.14	3.17	3.38	3.56	4.12	4.88	4.18	3.56	3.45	3.31	3.14	3.18
28	3.12	3.16	3.29	3.60	4.10	4.80	4.14	3.51	3.38	3.33	3.20	3.15
29	3.13	.....	3.32	3.59	4.15	4.86	4.04	3.50	3.36	3.32	3.27	3.15
30	3.10	.....	3.36	3.55	4.10	4.92	3.98	3.50	3.41	3.32	3.20	3.15
31	3.14	.....	3.25	.....	4.04	.....	3.93	3.50	.....	3.32	.....	3.15
1908.[b]												
1	3.2	3.1	3.1	3.1	3.5	4.05	4.2	3.6	3.4	3.4	3.3	3.2
2	3.2	3.1	3.05	3.05	3.6	4.05	4.2	3.6	3.35	3.3	3.2	3.15
3	3.15	3.1	3.1	3.15	3.75	4.1	4.1	3.55	3.3	3.3	3.2	3.2
4	3.2	3.1	3.1	3.15	3.65	4.25	4.1	3.5	3.3	3.3	3.2	3.3
5	3.2	3.1	3.1	3.2	3.6	4.25	4.1	3.5	3.3	3.35	3.2	3.2
6	3.15	3.1	3.1	3.2	3.6	4.25	4.0	3.5	3.3	3.3	3.15	3.25
7	3.15	3.1	3.0	3.2	3.6	4.2	4.0	3.5	3.3	3.3	3.15	3.2
8	3.15	3.1	3.0	3.2	3.7	4.15	4.0	3.5	3.3	3.3	3.1	3.3
9	3.15	3.1	3.1	3.35	3.8	4.2	3.95	3.5	3.3	3.3	3.2	3.35
10	3.2	3.1	3.1	3.4	3.75	4.4	4.0	3.5	3.3	3.3	3.2	3.3
11	3.2	3.1	3.1	3.5	3.7	4.5	4.0	3.5	3.3	3.3	3.2	3.2
12	3.2	3.1	3.1	3.55	3.7	4.6	4.0	3.6	3.3	3.3	3.2	3.25
13	3.2	3.1	3.15	3.55	3.65	4.5	3.95	3.6	3.4	3.3	3.3	3.3
14	3.15	3.05	3.2	3.6	3.65	4.55	3.95	3.55	3.35	3.25	3.25	3.25
15	3.15	3.05	3.2	3.7	3.6	4.6	3.95	3.5	3.3	3.2	3.25	3.25
16	3.15	3.1	3.25	3.7	3.7	4.6	3.95	3.5	3.3	3.25	3.25	3.2
17	3.15	3.1	3.2	3.7	3.85	4.65	3.85	3.5	3.3	3.3	3.25	3.2
18	3.15	3.1	3.2	3.7	3.85	4.55	3.8	3.5	3.3	3.3	3.25	3.2
19	3.15	3.1	3.15	3.65	3.9	4.35	3.75	3.5	3.3	3.3	3.2	3.2
20	3.15	3.1	3.15	3.6	4.05	4.35	3.7	3.6	3.3	3.4	3.2	3.3
21	3.15	3.1	3.1	3.65	3.95	4.45	3.7	3.6	3.25	3.4	3.2	3.45
22	3.15	3.05	3.2	3.7	3.95	4.6	3.7	3.6	3.25	3.3	3.2	3.95
23	3.1	3.05	3.15	3.7	3.95	4.5	3.7	3.65	3.25	3.3	3.15	3.95
24	3.1	3.1	3.1	3.55	3.85	4.45	3.7	3.6	3.25	3.3	3.1	3.9
25	3.1	3.1	3.1	3.45	4.05	4.45	3.7	3.6	3.3	3.3	3.2	4.0
26	3.1	3.1	3.15	3.45	4.0	4.4	3.6	3.6	3.3	3.2	3.2	3.9
27	3.1	3.05	3.1	3.45	3.95	4.4	3.6	3.6	3.3	3.15	3.2	3.8
28	3.15	3.1	3.15	3.45	3.95	4.4	3.6	3.6	3.3	3.2	3.2	3.5
29	3.1	3.1	3.1	3.45	3.9	4.25	3.55	3.55	3.35	3.3	3.15	3.5
30	3.1	.....	3.15	3.4	3.9	4.2	3.55	3.5	3.35	3.35	3.25	3.4
31	3.1	.....	3.15	.....	3.95	.....	3.65	3.45	.....	3.2	.....	3.25

[a] Discharge more or less affected by ice conditions from about January 1 to March 15, and about November 12 to December 31, 1907. Most of the gage heights during this period are afternoon readings.

[b] Discharge more or less affected by ice conditions from January 1 to about the end of March, and from about the 1st of November to December 31, 1908.

Rating tables for Williams Fork near Sulphur Springs, Colo.

1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	30	3.60	130	4.20	415	4.80	970
3.10	38	3.70	160	4.30	490	4.90	1,080
3.20	50	3.80	200	4.40	570	5.00	1,200
3.30	64	3.90	240	4.50	660		
3.40	82	4.00	290	4.60	760		
3.50	105	4.10	345	4.70	860		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1907, and is well defined below gage height 4.2 feet.

JANUARY 1 TO JUNE 17, 1908, AND OCTOBER 1 TO NOVEMBER 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	30	3.50	102	4.00	267	4.50	614
3.10	38	3.60	127	4.10	321	4.60	702
3.20	50	3.70	154	4.20	384	4.70	798
3.30	64	3.80	185	4.30	456		
3.40	82	3.90	221	4.40	533		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during above periods, and is well defined.

JUNE 18 TO SEPTEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	41	3.60	113	4.00	248	4.40	510
3.30	55	3.70	139	4.10	300	4.50	598
3.40	72	3.80	169	4.20	360	4.60	693
3.50	91	3.90	205	4.30	430		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on five discharge measurements made during latter part of 1908 and the form of earlier curves. It is well defined.

NOVEMBER 6 TO DECEMBER 19, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	40	3.20	58	3.40	86	3.50	102
3.10	48	3.30	71				

NOTE.—The above table is applicable only for ice conditions. It is based on one discharge measurement made during the above period and is not well defined.

Monthly discharge of Williams Fork near Sulphur Springs, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907					
January	57	38	46.7	2,870	C.
February	49	40	43.6	2,420	C.
March	250	43	76.3	4,690	B.
April	216	69	120	7,140	A.
May	530	105	249	15,300	A.
June	1,100	312	786	46,800	A.
July	1,190	255	580	35,700	A.
August	232	105	154	9,470	A.
September	100	64	74.9	4,460	B.
October	103	66	77.8	4,780	B.
November	64	30	48.7	2,900	B.
December	64	36	47.8	2,940	C.
The year	1,190	30	192	139,000	
1908.					
January	50	38	44.0	2,710	B.
February	38	34	37.3	2,150	B.
March	57	30	41.5	2,550	B.
April	154	34	98.5	5,860	B.
May	293	102	190	11,700	A.
June	749	293	511	30,400	A.
July	360	102	207	12,700	A.
August	126	82	101	6,210	A.
September	72	48	56.4	3,360	B.
October	82	44	63.4	3,900	B.
November	71	48	57.4	3,420	C.
December	.....	.....	57.5	3,540	C.
The year	749	30	122	88,500	

NOTE.—Ice conditions and discharge estimated December 20–31, 1908. The open-channel rating was applied for all other periods of possible ice conditions 1907–8. In general the main channel of the stream is but little affected by ice due to warm spring water entering above the station.

BLUE RIVER NEAR KREMMLING, COLO.

Blue River rises among the peaks of the Continental Divide in the extreme southeastern part of Summit County and joins Grand River just above the point where the latter stream enters Gore Canyon.

This station, which was established July 21, 1904, to determine the availability of the stream for storage, power, and irrigation, was discontinued November 30, 1908. It was located at the state highway bridge on the road between Kremmling and Dillon, Colo. The nearest railroad point is Kremmling, on the Denver, Northwestern and Pacific Railway, about 16 miles distant.

The locality is below all important tributaries, although it is several miles above the mouth of the stream. The drainage area is about 700 square miles.

A number of small irrigation ditches divert water above the station. Numerous filings have been made for the rights above, but these do not call for all the available power. The present power development above the station amounts to about 2,000 horsepower.

During the winter months ice forms in the channel to such an extent as to make accurate gage readings and discharge measurements impossible.

The datum of the chain gage on the bridge remained practically unchanged during the maintenance of the station.

Because of the very rough channel and severe winter conditions results are not very satisfactory.

Discharge measurements of Blue River near Kremmling, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	C. L. Chatfield	137	231	3.00	664
June 20	do	164	476	4.30	2,600
July 17	do	161	382	3.62	1,730
August 9	do	154	277	3.05	946
September 29	Freeman and Stewart	121	149	2.47	271
November 22	J. B. Stewart	80	98	2.12	144
1908.					
January 23[a]	J. B. Stewart	55	73	1.70	164
March 3[b]	do	32	48	1.78	81
March 19[b]	C. L. Chatfield	48	73	2.40	136
July 3	Hoyt and Freeman	156	293	3.40	1,080
August 20	C. L. Chatfield	150	218	3.00	661
November 26[c]	do	73	85	2.05	136

[a] River frozen across. Ice 1.1 to 2.2 feet thick.
[b] Ice conditions. Wading measurement.
[c] Ice conditions.

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1907 and 1908.

[T. G. Marcott and Jessie Marcott, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1					2.55	3.10	4.75	3.45	2.72	2.42	2.28	2.15
2					2.55	3.15	4.65	3.42	2.72	2.48	2.28	2.10
3					2.58	3.68	4.60	3.35	2.68	2.50	2.22	2.00
4					2.58	3.60	4.40	3.38	2.60	2.52	2.25	2.05
5					2.60	3.65	4.45	3.22	2.62	2.42	2.30	2.10
6					2.60	3.82	4.40	3.15	2.65	2.52	2.28	2.18
7					2.60	3.75	4.40	3.00	2.62	2.60	2.30	2.22
8					2.58	3.70	4.50	3.05	2.65	2.60	2.28	2.30
9					2.65	3.70	4.45	3.08	2.62	2.55	2.25	2.25
10					2.68	3.70	4.50	3.10	2.55	2.50	2.25	2.25
11					2.85	3.80	4.25	3.05	2.50	2.48	2.20	.....
12					3.10	3.85	4.15	3.10	2.50	2.48	2.15	.....
13					3.00	4.30	4.05	3.02	2.50	2.48	2.15	.....
14					2.90	4.55	4.10	3.02	2.52	2.45	2.20	.....
15					2.85	4.65	3.75	3.05	2.62	2.45	2.20	.....
16					2.85	4.55	3.75	3.05	2.62	2.40	2.30	.....
17					3.00	4.65	3.60	3.00	2.52	2.35	2.30	.....
18					3.02	4.60	3.60	2.98	2.52	2.35	2.30	.....
19					3.15	4.85	3.55	3.00	2.50	2.32	2.20	.....
20					3.55	4.55	3.65	2.98	2.42	2.30	2.20	.....
21					3.80	4.25	3.60	2.98	2.40	2.30	2.18	.....
22					3.80	4.25	3.58	2.90	2.40	2.30	2.18	.....
23					3.78	4.50	3.55	2.82	2.40	2.25	2.15	.....
24					3.65	4.65	3.58	2.80	2.40	2.25	2.10	.....
25					3.65	4.60	3.70	2.80	2.40	2.22	2.20	.....
26					3.65	4.65	3.72	3.05	2.48	2.30	2.25	.....
27					3.35	4.60	3.82	2.90	2.55	2.30	2.20	.....
28				2.68	3.40	4.52	3.72	2.80	2.48	2.28	2.35	.....
29				2.75	3.45	4.50	3.65	2.70	2.40	2.28	2.20	.....
30				2.60	3.32	4.65	3.55	2.82	2.40	2.30	2.08	.....
31					3.15	.....	3.45	2.80	.....	2.30	.....	.....

[a] Ice conditions prevailed after about the middle of November, 1907.

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	.....	2.6	.....	2.0	2.5	3.3	3.4	2.8	2.5	2.35	2.2	.....
2	.....	.....	2.5	.....	2.55	3.6	3.5	2.8	2.4	2.25	2.2	.....
3	.....	2.7	.....	.....	2.9	3.5	3.4	2.9	2.4	2.25	2.15	.....
4	.....	.....	2.6	2.1	2.7	3.7	3.45	2.8	2.4	2.3	2.15	.....
5	.....	2.7	.....	.....	2.7	3.7	3.4	2.7	2.4	2.3	2.15	.....
6	.....	.....	.....	2.2	2.6	3.75	3.35	2.7	2.4	2.35	2.1	.....
7	.....	.....	2.65	.....	2.75	3.3	3.3	2.75	2.4	2.35	2.0	.....
8	.....	2.5	.....	2.2	2.9	3.4	3.3	2.7	2.3	2.3	2.1	.....
9	.....	.....	2.55	.....	2.65	3.5	3.3	2.8	2.3	2.3	2.2	.....
10	.....	3.8	.....	.....	2.8	3.7	3.3	2.6	2.4	2.3	2.1	.....
11	.....	.....	2.7	2.4	2.8	4.0	3.35	3.0	2.4	2.2	2.1	.....
12	.....	3.3	.....	2.65	2.8	4.4	3.3	2.8	2.3	2.2	2.1	.....
13	.....	.....	.....	2.7	2.75	4.3	3.4	2.6	2.4	2.2	2.2	.....
14	.....	.....	2.7	2.5	2.75	4.0	3.2	2.7	2.5	2.3	2.2	.....
15	.....	2.9	.....	2.7	2.65	3.9	3.3	2.7	2.4	2.35	2.2	.....
16	.....	.....	2.7	2.75	2.7	3.8	3.4	2.7	2.3	2.35	2.15	.....
17	.....	2.4	.....	2.7	3.1	4.1	3.3	2.6	2.3	2.3	2.1	.....
18	.....	.....	2.65	2.9	3.1	3.9	3.3	2.6	2.4	2.2	2.1	.....
19	.....	2.35	2.4	2.7	3.3	3.8	3.0	2.7	2.35	2.2	2.1	.....
20	.....	.....	.....	2.65	3.45	3.6	3.1	2.7	2.3	2.15	2.15	.....
21	.....	.....	2.5	2.7	3.1	3.6	2.9	2.9	2.3	2.1	2.2	.....
22	2.7	2.4	.....	2.6	3.3	3.8	2.85	2.8	2.3	2.1	2.2	.....
23	2.55	.....	2.4	2.85	3.4	3.55	2.8	2.7	2.25	2.2	2.2	.....
24	.....	2.3	.....	2.7	3.1	3.5	2.8	2.7	2.3	2.2	2.15	.....
25	2.65	.....	2.45	2.6	3.35	3.3	2.75	2.6	2.3	2.25	2.2	.....
26	.....	2.4	.....	2.45	3.0	3.45	2.8	2.65	2.4	2.2	2.2	.....
27	.....	.....	.....	2.6	3.3	3.4	3.0	2.6	2.4	2.1	2.1	.....
28	.....	.....	2.35	2.35	3.0	3.3	2.8	2.6	2.3	2.2	2.0	.....
29	.....	2.45	.....	2.4	2.85	3.5	2.75	2.5	2.3	2.2	2.2	.....
30	.....	.....	.....	2.4	2.9	3.5	2.7	2.5	2.3	2.15	2.2	.....
31	.....	.....	.....	.....	3.1	.....	2.9	2.5	.....	2.2	.....	.....

[a] Ice conditions January 1 to March 31 and from about November 25 to December 31, 1908.

Rating tables for Blue River near Kremmling, Colo.

APRIL 28 TO JULY 31, 1907, AND APRIL 1 TO AUGUST 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	50	2.80	470	3.60	1,720	4.40	4,070
2.10	75	2.90	560	3.70	1,950	4.50	4,460
2.20	105	3.00	670	3.80	2,200	4.60	4,850
2.30	140	3.10	800	3.90	2,460	4.70	5,250
2.40	185	3.20	940	4.00	2,730	4.80	5,650
2.50	240	3.30	1,100	4.10	3,020	4.90	6,050
2.60	310	3.40	1,290	4.20	3,340		
2.70	390	3.50	1,500	4.30	3,690		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during the above periods and is not well defined.

AUGUST 1 TO DECEMBER 10, 1907, AND SEPTEMBER 1 TO NOVEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	65	2.40	260	2.80	600	3.20	1,160
2.10	95	2.50	330	2.90	710	3.30	1,360
2.20	140	2.60	410	3.00	840	3.40	1,590
2.30	195	2.70	500	3.10	990	3.50	1,850

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during the above periods and is not well defined.

Monthly discharge of Blue River near Kremmling, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.[a]					
May	2,200	275	919	56,500	B.
June	5,850	800	3,520	209,000	B.
July	5,450	1,400	2,850	175,000	B.
August	1,720	500	917	56,400	A.
September	520	260	360	21,400	B.
October	410	151	261	16,000	C.
November	228	89	156	9,280	C.
December	.....	.....	149	9,160	D.
The period	.....	.....	.....	553,000	
1908.[b]					
January	.....	.....	161	9,900	D.
February	.....	.....	136	7,820	D.
March	.....	.....	117	7,190	D.
April	560	50	253	15,100	C.
May	1,400	240	649	39,900	C.
June	4,070	1,100	1,940	115,000	C.
July	1,500	390	916	56,300	C.
August	670	240	393	24,200	C.
September	330	168	232	13,800	C.
October	228	95	164	10,100	C.
November	140	65	117	6,960	D.
The period	.....	.....	.....	306,000	

[a] Discharge estimated for December 11 to 31, 1907. Open-channel rating used for November and December 1 to 10, 1907.

[b] Ice conditions during January, February, and March, 1908, and discharge estimated. Discharge interpolated for days in April, 1908 that have no gage record. Open-channel rating used November, 1908.

EAGLE RIVER BASIN.

EAGLE RIVER NEAR EAGLE, COLO.

Eagle River rises in the Continental Divide, opposite the headwaters of the Arkansas, flows a little north of west for about 20 miles, and then takes a general westerly course to its junction with the Grand.

The gaging station was established March 12, 1905, and was discontinued February 10, 1907, in favor of the station at Gypsum. It was located at Rule's private road bridge, in T. 5 S., R. 85 W., 2½ miles below Eagle, Colo., and below mouth of Brush Creek. The record at this point shows practically the same discharge as the station at Gypsum, about 5 miles below, as no tributaries of any consequence enter between the two points.

Results obtained at this station were good for open-channel conditions. During the winter, as the river does not freeze over entirely, the results were fair.

Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1907.

[Kenneth Rule, observer.]

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1	0.9	0.8	9	.9	.8	17	.7	.....	25	.8	.....
2	.9	.8	10	.9	.8	18	.7	.....	26	.8	.....
3	.8	.8	11	.9	.....	19	.8	.....	27	.8	.....
4	1.1	.9	12	.8	.....	20	.8	.....	28	.9	.....
5	1.0	1.1	13	.9	.....	21	.8	.....	29	.9	.....
6	1.0	.9	14	.9	.....	22	.8	.....	30	.9	.....
7	1.0	.9	15	.8	.....	23	.8	.....	31	.9	.....
8	1.0	.85	16	.7	.....	24	.8	.....			

Rating table for Eagle River near Eagle, Colo., for 1905 to 1907.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	183	1.00	230
.90	205	1.10	255

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905–6, and is well defined.

Monthly discharge of Eagle River near Eagle, Colo., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	255	163	197	12,100	C.
February 1–10	255	183	198	3,930	C.

EAGLE RIVER AT GYPSUM, COLO.

This station, which was established February 7, 1907, to replace the station at Eagle, a few miles above, is located at the highway bridge one-fourth mile north of the Denver and Rio Grande Railroad station at Gypsum. It was abandoned December 31, 1909.

The station has been maintained to obtain data for use in connection with power and irrigation development.

Gypsum Creek, the only tributary of consequence, enters about one-eighth mile below the station. The drainage area above the mouth of Gypsum Creek is about 800 square miles.

A number of ditches divert water for irrigation, but such ditches are small, as the valley is generally narrow.

The stream is frozen along the edges during the winter, and some slush and anchor ice also forms, but the river usually remains open in midstream.

The location and datum of the chain gage on the highway bridge have remained the same during the maintenance of the station.

Channel conditions are permanent, but measurements are only fairly satisfactory because of the rough and rocky bottom. Winter records are affected by ice and are only fairly accurate.

Discharge measurements of Eagle River at Gypsum, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 7[a]	R. I. Meeker	80	141	2.50	158
April 28	do	96	229	3.50	579
June 8	W. B. Freeman	96	451	5.78	2,880
July 31	C. L. Chatfield	106	307	4.20	1,070
August 20	do	95	237	3.35	533
October 17	J. B. Stewart	86	194	2.80	230
November 15	do	81	166	2.51	168
1908.					
February 13[b]	J. B. Stewart	60	116	2.38	130
April 13	do	90	225	3.22	395
May 8	C. L. Chatfield			3.55	565
June 19	do	96	350	4.55	1,410
July 7	Hoyt and Freeman	96	293	4.15	959
July 21	C. L. Chatfield	95	230	3.30	428
August 22	do	95	221	3.28	452
September 21	do	84	158	2.70	188
October 26	do	85	157	2.60	178
November 29[a]	do	82	149	2.50	158

[a] No ice in channel. [b] Stream open except along edges.

Daily gage height, in feet, of Eagle River at Gypsum, Colo., for 1907 and 1908.

[J. F. Greenland, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	.....	.....	2.4	2.9	3.5	4.2	6.2	4.15	3.4	3.1	2.8	2.5
2	.....	.....	2.5	2.95	3.4	4.35	6.1	3.95	3.25	3.1	2.8	2.5
3	.....	.....	2.4	2.95	3.35	4.82	6.05	3.9	3.2	3.1	2.8	2.5
4	.....	.....	2.45	2.95	3.35	5.55	6.0	3.85	3.1	3.1	2.8	2.4
5	.....	.....	2.5	3.0	3.35	5.65	6.0	4.0	3.15	3.1	2.8	2.4
6	.....	.....	2.5	3.0	3.35	5.7	5.8	3.9	3.2	3.1	2.8	2.45
7	.....	2.5	2.45	2.95	3.35	5.6	5.7	3.8	3.2	3.3	2.8	2.5
8	.....	2.4	2.45	3.0	3.35	5.65	5.8	3.75	3.15	3.2	2.8	2.4
9	.....	2.35	2.45	3.2	3.35	5.6	5.75	3.75	3.1	3.15	2.8	2.4
10	.....	2.5	2.5	3.2	3.35	5.3	5.7	3.7	3.05	3.1	2.8	2.4
11	.....	2.45	2.45	3.55	3.55	5.3	5.55	3.6	3.0	3.1	2.7	2.4
12	.....	2.5	2.45	3.7	3.9	5.65	5.35	3.5	3.0	3.1	2.3	2.4
13	.....	2.5	2.4	3.8	3.95	5.82	5.45	3.4	3.0	3.05	2.45	2.4
14	.....	2.5	2.4	3.85	3.85	6.0	5.6	3.35	3.0	3.0	2.55	2.4
15	.....	2.45	2.35	4.0	3.75	6.25	5.2	3.3	3.05	3.0	2.56	2.15
16	.....	2.45	2.4	4.15	3.7	6.3	5.05	3.3	3.2	3.0	2.55	2.1
17	.....	2.45	2.5	4.0	3.85	6.25	4.85	3.2	3.15	2.9	2.5	2.1
18	.....	2.5	2.5	4.15	3.9	6.15	4.7	3.25	3.1	2.9	2.5	2.05
19	.....	2.55	2.7	3.95	4.05	6.25	4.6	3.35	3.1	2.9	2.5	2.0
20	.....	2.5	3.0	3.7	4.85	5.95	4.6	3.3	3.0	2.9	2.5	2.3
21	.....	2.55	3.05	3.35	5.5	5.75	4.6	3.3	3.0	2.8	2.4	2.45
22	.....	2.55	3.1	3.4	5.5	6.1	4.55	3.3	3.0	2.8	2.4	2.5
23	.....	2.55	2.95	3.35	5.5	5.85	4.45	3.25	2.9	2.8	2.4	2.5
24	.....	2.55	2.95	3.4	5.4	5.9	4.4	3.25	2.9	2.8	2.5	2.5
25	.....	2.5	2.95	3.45	5.2	6.15	4.55	3.3	2.9	2.8	2.5	2.5
26	.....	2.5	2.95	3.35	4.8	6.0	5.1	3.4	3.0	2.8	2.5	2.5
27	.....	2.5	2.95	3.4	4.45	6.1	5.05	3.2	3.1	2.8	2.5	2.5
28	.....	2.5	2.85	3.45	4.4	6.05	4.7	3.2	3.1	2.8	2.5	2.5
29	.....	.....	2.85	3.45	4.4	6.05	4.4	3.2	3.1	2.8	2.5	2.5
30	.....	.....	2.8	3.5	4.5	6.15	4.3	3.25	3.1	2.8	2.5	2.4
31	.....	.....	2.8	.....	4.3	.....	4.2	3.45	.....	2.8	.....	2.4

[a] Probably occasional slight ice conditions November and December, 1907.

Daily gage height, in feet, of Eagle River at Gypsum, Colo., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	2.5	2.8	2.3	2.5	3.15	4.25	4.35	3.4	3.0	2.7	2.5	2.4
2	2.5	2.75	2.3	2.5	3.3	4.3	4.3	3.35	2.9	2.7	2.5	2.4
3	2.5	2.55	2.3	2.4	3.6	4.7	4.25	3.2	2.9	2.7	2.5	2.4
4	2.5	2.5	2.3	2.4	3.45	5.35	4.15	3.1	2.8	2.6	2.5	2.5
5	2.55	2.45	2.3	2.45	3.4	5.1	4.05	3.1	2.8	2.6	2.5	2.5
6	2.6	2.45	2.3	2.5	3.4	5.25	4.0	3.1	2.8	2.6	2.5	2.45
7	2.6	2.45	2.2	2.55	3.45	4.8	4.0	3.1	2.75	2.6	2.5	2.4
8	2.6	2.45	2.2	2.65	3.6	4.5	3.9	3.1	2.75	2.6	2.5	2.4
9	2.6	2.45	2.2	2.7	3.9	4.85	4.05	3.0	2.8	2.55	2.5	2.4
10	2.6	2.4	2.25	2.8	3.7	5.35	4.1	3.0	2.8	2.55	2.5	2.45
11	2.75	2.4	2.3	2.9	3.7	5.7	3.95	3.25	2.8	2.5	2.5	2.45
12	3.05	2.4	2.3	3.1	3.65	5.75	3.95	3.5	2.8	2.5	2.5	2.5
13	3.0	2.4	2.3	3.2	3.6	5.4	3.95	3.35	2.8	2.5	2.5	2.4
14	2.95	2.4	2.3	3.3	3.6	5.55	3.95	3.3	2.8	2.5	2.4	2.4
15	2.75	2.4	2.35	3.5	3.5	5.5	4.05	3.25	2.8	2.5	2.4	2.4
16	2.8	2.4	2.4	3.6	3.5	5.3	3.95	3.15	2.8	2.5	2.35	2.45
17	2.85	2.4	2.45	3.6	3.6	5.6	3.25	3.1	(b)	2.5	2.4	2.4
18	2.85	2.4	2.45	3.5	4.45	5.4	3.05	3.15	(b)	2.55	2.45	2.25
19	2.95	2.4	2.45	3.7	4.5	4.6	3.3	3.2	(b)	2.7	2.45	2.15
20	2.85	2.4	2.45	3.8	4.4	4.6	3.3	3.2	(b)	2.65	2.45	2.1
21	2.6	2.45	2.45	3.9	4.4	4.9	3.35	3.25	2.7	2.65	2.45	2.1
22	2.55	2.45	2.4	3.9	4.3	5.5	3.25	3.25	2.7	2.65	2.45	2.15
23	2.55	2.45	2.4	4.0	4.3	5.45	3.2	3.25	2.6	2.6	2.5	2.3
24	2.55	2.45	2.5	3.9	4.4	5.25	3.2	3.2	2.6	2.6	2.5	2.7
25	2.55	2.4	2.5	3.9	4.25	5.25	3.2	3.1	2.6	2.6	2.5	3.1
26	2.55	2.3	2.5	3.6	4.15	5.05	3.1	3.0	2.65	2.6	2.4	3.05
27	2.55	2.3	2.5	3.25	4.0	5.05	3.1	3.0	2.7	2.55	2.35	3.05
28	2.5	2.3	2.5	3.2	4.0	4.9	3.1	3.0	2.65	2.5	2.4	3.1
29	2.5	2.3	2.5	3.05	3.7	4.5	3.1	3.0	2.65	2.55	2.4	3.1
30	2.5	.....	2.5	3.05	4.0	4.4	3.15	3.0	2.65	2.55	2.4	3.05
31	2.5	.....	2.5	.....	4.3	.....	3.35	2.95	.....	2.55	.....	3.05

[a] Ice conditions January 11–20 and December 22–31, 1908, and probably slight effect for short intervals at other times during the winter periods.
[b] Gage weight missing.

Rating table for Eagle River at Gypsum, Colo., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	60	3.00	307	4.00	890	5.00	1,900
2.10	75	3.10	346	4.10	970	5.20	2,145
2.20	92	3.20	389	4.20	1,055	5.40	2,395
2.30	111	3.30	438	4.30	1,145	5.60	2,655
2.40	132	3.40	491	4.40	1,240	5.80	2,925
2.50	155	3.50	548	4.50	1,340	6.00	3,210
2.60	181	3.60	609	4.60	1,445	6.20	3,505
2.70	209	3.70	674	4.70	1,555	6.30	3,660
2.80	239	3.80	743	4.80	1,665		
2.90	272	3.90	815	4.90	1,780		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907–1909, and is well defined above gage height 2.3 feet.

Monthly discharge of Eagle River at Gypsum, Colo., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
February 7–28	168	122	153	6,680	A.
March	346	122	200	12,300	A.
April	1,010	272	540	32,100	A.
May	2,520	464	1,080	66,400	A.
June	3,660	1,060	2,890	172,000	A.
July	3,500	1,060	2,160	133,000	A.
August	1,010	389	562	34,600	A.
September	491	272	342	20,400	A.
October	438	239	299	18,400	A.
November	239	111	182	10,800	A.
December	155	60	131	8,060	C.
The year				515,000	
1908.					
January	181	155	170	10,500	C.
February	239	111	142	8,170	C.
March	155	92	128	7,870	A.
April	890	132	436	25,900	A.
May	1,340	368	806	49,600	A.
June	2,860	1,100	2,010	120,000	A.
July	1,190	326	675	41,500	A.
August	548	290	375	23,100	A.
September	307	181	226	13,400	A.
October	209	155	176	10,800	A.
November	155	122	146	8,690	A.
December	155	75	119	7,320	C.
The year	2,860	75	451	327,000	

NOTE.—Ice conditions and discharge estimated for January 11–20 and December 22–31, 1908. Open-channel rating applied for remainder of winter periods; effect from ice small. Discharge estimated for days in September, 1908, that have no gage record.

ROARING FORK BASIN.

DESCRIPTION.

Roaring Fork, which enters the Grand at Glenwood Springs, drains a large area lying chiefly in Pitkin County and reaching to the Continental Divide. It is one of the largest tributaries of the Grand. Frying Pan and Crystal rivers are its most important branches.

ROARING FORK NEAR EMMA, COLO.

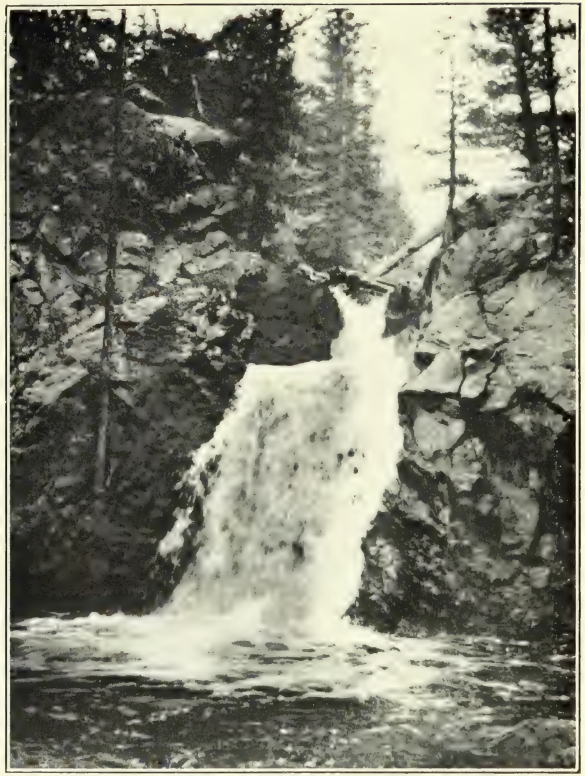
This station is located on a steel highway bridge about 1½ miles below Emma, a station on the Aspen branch of the Denver and Rio Grande Railroad. It was established July 19, 1908, to obtain run-off data for the development of storage and power. (See Pl. VII, *A*.)

Frying Pan Creek joins Roaring Fork about 3 miles above the station, and Sopris Creek comes in above the station near Emma. The drainage area at the station is more than 500 square miles.

A few small ditches divert water above the station, principally for meadow irrigation. The only important power plant above the station is that at Aspen, Colo., which generates 1,000 horsepower.

The stream at this point is not so much affected by ice as at other stations in that vicinity, and open channel conditions are frequent. Slush ice is common.

A staff gage was used until August 27, 1908, at which time a chain gage was established on the bridge with a datum 0.10 foot above that of the staff gage. Gage heights are all referred to the datum of the chain gage.



A. FALLS ON ROARING FORK, COLORADO.

B. DIVERSION DAM OF ANIMAS POWER COMPANY, ON CASCADE CREEK ABOVE DURANGO, COLO.

Results at this station are satisfactory except when affected by ice conditions during very severe winters.

Discharge measurements of Roaring Fork near Emma, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 2[a]	C. L. Chatfield	93	200	.....	224
April 4[a]	do	59	172	3.58	250
May 13[a]	do	83	237	4.55	614
July 19[a]	Freeman and Chatfield	86	282	5.28	1,070
Do	do	109	314	5.30	1,120
August 27	C. L. Chatfield	107	260	4.60	678
September 25	do	100	172	3.95	372
October 29[b]	do	90	164	3.80	319
December 2	do	80	119	3.35	179

[a] Measurements made at bridge 1 mile below Basalt. [b] Open channel; slush ice.

NOTE.—All above measurement referred to the same gage.

Daily gage height, in feet, of Roaring Fork near Emma, Colo., for 1908.

[W. R. Hook, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.45	4.2	4.0	3.8	3.4	17	.....	4.75	3.95	3.9	3.6	3.6
2	.....	5.5	4.1	4.0	3.8	3.4	18	.....	4.85	3.9	3.9	3.65	3.5
3	.....	5.15	4.15	4.0	3.8	3.5	19	5.3	5.0	3.9	3.95	3.6	3.3
4	.....	4.95	4.1	4.0	3.75	3.6	20	5.25	5.0	3.9	3.95	3.6	3.3
5	.....	4.8	4.0	4.0	3.7	3.6	21	5.2	4.85	3.9	3.95	3.6	3.4
6	.....	4.8	4.0	3.95	3.7	3.6	22	5.1	4.8	3.9	3.9	3.6	3.55
7	.....	4.75	4.0	3.95	3.7	3.4	23	5.0	4.8	3.9	3.75	3.6	3.8
8	.....	4.65	3.9	3.9	3.7	3.4	24	5.0	4.7	3.8	3.85	3.6	3.6
9	.....	4.55	3.9	3.9	3.7	3.5	25	4.9	4.7	3.9	3.9	3.6	3.5
10	.....	4.5	4.05	3.85	3.7	3.6	26	4.85	4.65	4.05	3.85	3.5	3.6
11	.....	5.0	4.0	3.85	3.65	3.6	27	4.8	4.6	4.0	3.8	3.45	3.5
12	.....	5.25	3.95	3.85	3.65	3.4	28	4.85	4.5	4.0	3.85	3.5	3.75
13	.....	4.9	4.0	3.85	3.7	3.4	29	4.95	4.45	4.0	3.8	3.5	3.65
14	.....	5.05	4.0	3.8	3.55	3.4	30	4.85	4.4	4.05	.....	3.5	3.5
15	.....	4.9	4.0	3.8	3.65	3.6	31	5.3	4.3	.....	.....	.....	3.7
16	.....	4.75	4.0	3.85	3.55	3.6							

NOTE.—Slight ice conditions November 14 to December 31.

Rating table for Roaring Fork near Emma, Colo., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	176	3.90	357	4.50	603	5.10	967
3.40	200	4.00	393	4.60	652	5.20	1,044
3.50	225	4.10	431	4.70	705	5.30	1,124
3.60	254	4.20	471	4.80	763	5.40	1,206
3.70	287	4.30	512	4.90	826	5.50	1,289
3.80	321	4.40	556	5.00	894	5.60	1,373

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on nine discharge measurements made during 1908–9, and is well defined.

Monthly discharge of Roaring Fork near Emma, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 19–31	1,120	763	918	23,700	A.
August	1,290	512	790	48,600	A.
September	471	321	388	23,100	A.
October	393	304	332	20,400	A.
November	321	212	266	15,800	A.
December	321	176	234	14,400	A.
The period	.....	.....	.....	146,000	

NOTE.—Open-channel rating applied November and December; effect from ice immaterial.

ROARING FORK AT GLENWOOD SPRINGS, COLO.

This station, which was established April 6, 1906, to obtain run-off data, valuable because of the opportunities for storage and power development offered by the river, is located at the mouth of the stream on a single-span wooden road bridge, about 500 feet above the junction of Grand River and Roaring Fork, and about four blocks west of Grand avenue, Glenwood Springs.

A number of small irrigation ditches divert water from the main stream and tributaries. Three important power plants, located on Crystal River, Yule Creek, and Maroon and Castle creeks, develop about 2,100 horsepower. A number of smaller plants are also in operation in this drainage area.

Surface ice rarely forms solid across the river at this station, although slush and anchor ice are common. Extremely high stages of Grand River may affect the flow at this station to a small degree.

Neither the location nor the datum of the chain gage on the bridge has been changed during the maintenance of the station.

As the stream bed is very rough, conditions are unfavorable for accurate measurements. The channel is, however, fairly permanent, and the results are satisfactory.

Discharge measurements of Roaring Fork at Glenwood Springs, Colo., in 1904, 1907, and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4					457
April 25					888
May 25					6,680
June 28					4,940
August 6					885
September 5					1,130
1907.					
February 6	R. I. Meeker	145	150	1.40	401
March 7	do	145	154	1.35	395
June 6	W. B. Freeman	169	760	5.10	5,730
June 22	do	169	794	5.26	5,830
July 28	C. L. Chatfield	166	609	4.20	3,750
August 18	do	155	382	2.50	1,530
October 16	J. B. Stewart	153	280	1.87	897
November 14[a]	do	149	209	1.41	466
1908.					
February 12[b]	J. B. Stewart	140	171	1.18	396
February 29	C. L. Chatfield	143	175	1.20	409
March 31	do	150	186	1.25	427
April 12	J. B. Stewart	154	292	1.95	947
May 11	C. L. Chatfield			2.58	1,580
June 21	do	167	601	4.10	3,680
July 8	Hoyt and Freeman	162	523	3.43	2,880
July 20	Freeman and Chatfield	156	409	2.70	1,750
August 24	C. L. Chatfield	155	302	2.10	1,090
September 23	do	149	185	1.40	442
October 28	do	148	189	1.45	502
December 1	do	143	166	1.20	465

[a] Some floating ice. [b] Fringe of ice along edges of river.

NOTE.—The measurements made in 1904 were not available for publication until the present time.

Daily gage height, in feet, of Roaring Fork at Glenwood Springs, Colo., for 1907 and 1908.

[Celia S. Linsley, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.38	1.35	1.32	1.65	2.30	3.50	6.28	3.75	2.28	1.90	1.65	1.30
2	1.30	1.38	1.30	1.68	2.30	3.80	6.52	3.60	2.20	1.88	1.62	1.35
3	1.25	1.42	1.30	1.78	2.20	4.60	6.18	3.60	2.18	1.82	1.60	1.35
4	1.38	1.45	1.35	1.85	2.20	4.60	6.18	3.60	2.15	1.85	1.58	1.28
5	1.45	1.45	1.35	1.92	2.15	5.10	6.20	3.58	2.18	1.80	1.55	1.30
6	1.45	1.38	1.35	1.95	2.10	5.15	6.20	3.35	2.15	1.80	1.55	1.32
7	1.35	1.32	1.35	1.85	2.20	5.20	6.05	3.38	2.10	2.05	1.55	1.35
8	1.35	1.25	1.32	1.82	2.20	5.10	6.00	3.35	2.10	1.95	1.58	1.35
9	1.40	1.32	1.30	1.95	2.20	5.10	5.68	3.22	2.05	1.90	1.50	1.30
10	1.35	1.32	1.32	2.25	2.30	4.65	5.65	3.08	1.98	1.90	1.50	1.32
11	1.35	1.28	1.35	2.68	2.50	5.00	5.20	3.10	2.00	1.85	1.45	1.35
12	1.30	1.30	1.38	2.90	2.80	5.15	5.10	2.98	1.98	1.85	1.42	1.35
13	1.35	1.32	1.32	3.10	2.80	5.60	5.00	2.95	1.92	1.85	1.32	1.35
14	1.38	1.32	1.30	3.28	2.60	5.80	5.35	2.90	1.98	1.85	1.40	1.30
15	1.35	1.28	1.32	3.35	2.60	6.05	5.05	2.85	2.12	1.80	1.42	1.20
16	1.35	1.32	1.35	3.42	2.60	6.10	4.65	2.88	2.30	1.87	1.58	1.30
17	1.35	1.30	1.32	3.18	2.75	6.20	4.45	2.78	2.18	1.75	1.48	1.22
18	1.35	1.38	1.58	2.95	2.95	6.10	4.48	2.65	2.10	1.81	1.50	1.12
19	1.35	1.32	1.65	2.78	3.50	6.20	4.35	2.75	2.08	1.82	1.50	1.15
20	1.28	1.32	1.92	2.58	4.00	5.70	4.30	2.72	2.00	1.75	1.50	1.20
21	1.22	1.35	1.98	2.50	4.65	5.60	4.38	2.65	2.00	1.70	1.42	1.30
22	1.25	1.38	2.00	2.42	4.80	5.35	4.30	2.52	1.98	1.69	1.40	1.34
23	1.30	1.42	1.88	2.45	5.00	5.48	4.20	2.42	1.90	1.70	1.30	1.40
24	1.30	1.38	1.82	2.40	4.60	5.85	4.08	2.30	1.85	1.71	1.30	1.36
25	1.38	1.32	1.80	2.40	4.40	6.10	4.52	2.28	1.80	1.75	1.34	1.36
26	1.40	1.35	1.88	2.38	3.95	6.05	4.85	2.45	1.90	1.70	1.40	1.35
27	1.38	1.38	1.80	2.40	3.90	6.10	4.78	2.32	1.90	1.70	1.32	1.32
28	1.35	1.35	1.78	2.42	3.80	5.88	4.42	2.30	1.90	1.69	1.35	1.30
29	1.40	.....	1.68	2.60	3.70	6.00	4.18	2.28	1.80	1.65	1.32	1.35
30	1.38	.....	1.65	2.60	3.70	6.30	4.08	2.25	1.90	1.65	1.30	1.20
31	1.35	.....	1.62	.....	3.60	.....	4.05	2.32	.....	1.65	.....	1.30
1908.												
1	1.3	1.1	1.25	1.2	2.2	3.4	3.95	2.5	1.5	1.55	1.5	1.2
2	1.2	1.2	1.25	1.25	2.35	3.6	3.75	2.6	1.5	1.5	1.45	1.15
3	1.3	1.25	1.25	1.3	2.5	3.55	3.75	2.55	1.6	1.5	1.45	1.25
4	1.25	1.25	1.3	1.4	2.4	4.5	3.85	2.4	1.5	1.5	1.4	1.3
5	1.3	1.15	1.4	1.5	2.4	4.0	4.0	2.2	1.5	1.5	1.4	1.25
6	1.25	1.1	1.35	1.5	2.4	4.1	3.7	2.1	1.5	1.5	1.4	1.2
7	1.2	1.2	1.3	1.5	2.5	4.0	3.65	2.1	1.45	1.5	1.4	1.1
8	1.2	1.2	1.2	1.55	2.6	3.7	3.6	2.05	1.5	1.5	1.4	1.2
9	1.3	1.2	1.3	1.6	2.9	4.3	3.45	1.95	1.5	1.45	1.4	1.2
10	1.3	1.25	1.3	1.65	2.7	4.8	3.35	2.1	1.45	1.45	1.4	1.2
11	1.2	1.15	1.3	1.8	2.6	4.9	3.45	2.35	1.45	1.4	1.4	1.2
12	1.2	1.2	1.3	1.95	2.5	5.4	3.35	2.65	1.5	1.45	1.4	1.2
13	1.2	1.15	1.3	2.2	2.45	5.5	3.25	2.5	1.5	1.45	1.3	1.2
14	1.3	1.1	1.3	2.4	2.3	5.45	3.2	2.45	1.5	1.45	1.3	1.3
15	1.4	1.15	1.4	2.55	2.3	5.05	3.25	2.35	1.5	1.45	1.25	1.35
16	1.2	1.2	1.4	2.7	2.35	4.9	3.15	2.2	1.5	1.5	1.25	1.4
17	1.2	1.25	1.6	2.6	2.9	4.9	3.05	2.2	1.5	1.5	1.25	1.3
18	1.3	1.2	1.6	2.5	3.1	4.8	2.85	2.3	1.45	1.55	1.25	1.15
19	1.25	1.1	1.5	2.6	3.6	4.5	2.75	2.4	1.45	1.55	1.25	1.0
20	1.3	1.2	1.45	2.75	3.8	4.25	2.6	2.4	1.4	1.6	1.25	1.0
21	1.3	1.2	1.4	2.8	3.4	3.95	2.5	2.4	1.45	1.5	1.25	1.2
22	1.35	1.2	1.4	2.8	3.3	4.2	2.5	2.25	1.45	1.5	1.25	1.2
23	1.25	1.25	1.4	2.9	3.2	4.45	2.4	2.2	1.5	1.5	1.25	1.25
24	1.3	1.25	1.45	2.7	3.25	4.8	2.3	2.15	1.4	1.5	1.3	1.25
25	1.3	1.3	1.5	2.45	3.1	4.85	2.2	2.1	1.5	1.5	1.3	1.15
26	1.3	1.3	1.5	2.4	3.0	4.7	2.2	2.0	1.5	1.5	1.3	1.2
27	1.3	1.25	1.5	2.35	3.0	4.8	2.2	1.95	1.6	1.5	1.3	1.2
28	1.3	1.25	1.45	2.3	2.9	4.75	2.2	1.95	1.6	1.5	1.25	1.1
29	1.25	1.2	1.3	2.15	2.75	4.3	2.3	1.9	1.55	1.45	1.25	1.1
30	1.2	.....	1.4	2.1	2.65	4.0	2.4	1.8	1.5	1.45	1.25	1.1
31	1.2	.....	1.35	.....	3.3	.....	2.4	1.65	.....	1.4	.....	1.15

NOTE.—Gage heights for the winter periods are probably more or less affected by ice conditions.

Rating tables for Roaring Fork at Glenwood Springs, Colo.

JANUARY 1 TO MARCH 17, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	250	1.30	330	1.40	410	1.50	490

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during above period and the form of the following rating curve. It is fairly well defined.

MARCH 18 TO NOVEMBER 30, 1907, AND APRIL 11 TO NOVEMBER 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	300	2.40	1,395	3.60	2,890	4.80	4,920
1.30	375	2.50	1,505	3.70	3,040	4.90	5,110
1.40	455	2.60	1,620	3.80	3,190	5.00	5,300
1.50	540	2.70	1,740	3.90	3,350	5.20	5,700
1.60	625	2.80	1,860	4.00	3,510	5.40	6,110
1.70	715	2.90	1,980	4.10	3,680	5.60	6,530
1.80	805	3.00	2,100	4.20	3,850	5.80	6,950
1.90	900	3.10	2,225	4.30	4,020	6.00	7,380
2.00	995	3.20	2,350	4.40	4,195	6.20	7,820
2.10	1,090	3.30	2,480	4.50	4,370	6.40	8,270
2.20	1,190	3.40	2,615	4.60	4,550		
2.30	1,290	3.50	2,750	4.70	4,730		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 13 discharge measurements made during 1907 and 1908, and is well defined.

DECEMBER 1, 1907, TO APRIL 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	350	1.30	450	1.50	580	1.70	730
1.20	400	1.40	510	1.60	650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during February to April, 1908, and is fairly well defined.

NOVEMBER 11 TO NOVEMBER 30, 1908.

[The indirect method for shifting channels used.]

DECEMBER 1 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	375	1.20	455	1.30	500	1.40	555
1.10	415						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made 1908–9 and form of the rating curve used December, 1907, to April 10, 1908. It is fairly well defined.

Daily discharge, in second-feet, of Roaring Fork, at Glenwood Springs, Colo., November 11 to 30, 1908.

Day.	Nov.	Day.	Nov.	Day.	Nov.
1		11	460	21	420
2		12	430	22	425
3		13	400	23	430
4		14	415	24	460
5		15	390	25	470
6		16	390	26	480
7		17	395	27	485
8		18	400	28	475
9		19	410	29	470
10		20	415	30	465
				31	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Roaring Fork at Glenwood Springs, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	450	266	368	22,600	C.
February	450	290	367	20,400	B.
March	995	330	554	34,100	B.
April	2,640	670	1,490	88,700	B.
May	5,300	1,090	2,410	148,000	B.
June	8,040	2,750	6,270	373,000	A.
July	8,000	3,600	5,500	338,000	A.
August	3,120	1,240	1,980	122,000	A.
September	1,290	805	1,030	61,300	A.
October	1,040	670	802	49,300	A.
November	670	375	504	30,000	A.
December	486	360	453	27,900	B.
The year	8,040	266	1,810	1,320,000	
1908.					
January	510	400	433	26,600	A.
February	450	350	400	23,000	A.
March	650	400	500	30,700	A.
April	1,980	400	1,160	69,000	A.
May	3,190	1,190	1,870	115,000	A.
June	6,320	2,620	4,380	261,000	A.
July	3,510	1,190	2,170	133,000	A.
August	1,680	670	1,210	74,400	A.
September	625	455	534	31,800	A.
October	625	455	530	32,600	A.
November	540	390	447	26,600	C.
December	555	375	455	28,000	B.
The year	6,320	350	1,180	852,000	

NOTE.—Discharge for November 11–30, 1908, determined by indirect method for shifting channels.

FRYING PAN RIVER AT BASALT, COLO.

This station, which was established July 19, 1908, to obtain run-off data necessary for studies of storage and power possibilities, is located at the wooden highway bridge, about 100 yards from the Colorado Midland depot and about 75 yards downstream from a concrete arch bridge in the town of Basalt.

The station is near the mouth of the stream below all tributaries of importance, and the records show the total run-off from the drainage basin.

Diversions above are limited to ditches used for meadow irrigation. Power and storage possibilities are good.

Severe ice conditions prevail during the winter months, and gage readings are at times distorted by the backwater caused by the freezing of the river below. Slush ice is also a disturbing factor.

The location and datum of the staff gage at the bridge have remained unchanged during the maintenance of the station.

The accuracy of the measurements is affected by the roughness of the stream bed and the high current velocities during flood periods.

Discharge measurements of Frying Pan River at Basalt, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 19[a]	R. I. Meeker	54	166	.....	63
1908.					
February 13[b]	C. L. Chatfield	45	60	.....	55
March 2[b]	do	45	72	1.33	56
April 4	do	45.5	79	1.52	87
May 14	do	48.5	108	2.25	243
July 19	Freeman and Chatfield	59.8	122	2.40	318
August 27	C. L. Chatfield	46.5	90	1.80	133
September 25	do	46.5	75	1.46	65
October 29	do	45.5	75	1.40	76
December 2[c]	do	46	88	2.00	53

[a] Through ice 100 feet above concrete bridge. [b] Wading measurement. [c] Ice conditions.

Daily gage height, in feet, of Frying Pan River at Basalt, Colo., for 1908.

[J. G. Ould, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.35	1.75	1.55	1.5	1.6	16	.....	2.05	1.65	1.5	1.45	2.45
2	.....	2.35	1.75	1.55	1.5	2.0	17	.....	2.1	1.65	1.5	1.45	2.7
3	.....	2.15	1.7	1.55	1.5	2.05	18	.....	2.0	1.6	1.5	1.45	2.7
4	.....	2.05	1.7	1.55	1.4	1.6	19	2.4	2.05	1.6	1.5	1.45	2.9
5	.....	2.0	1.7	1.5	1.5	1.0	20	2.25	2.1	1.6	1.55	1.45	3.5
6	.....	2.0	1.7	1.5	1.5	1.0	21	2.25	2.0	1.55	1.5	1.45	3.75
7	.....	2.0	1.6	1.5	1.45	1.0	22	2.2	2.0	1.55	1.5	1.4	3.6
8	.....	2.0	1.6	1.5	1.45	1.5	23	2.1	2.0	1.5	1.5	1.4	3.1
9	.....	2.0	1.6	1.5	1.45	2.05	24	2.1	2.0	1.5	1.5	1.4	3.0
10	.....	2.0	1.65	1.5	1.5	2.1	25	2.1	2.0	1.5	1.5	1.4	2.9
11	.....	2.15	1.65	1.5	1.5	2.15	26	2.2	2.0	1.7	1.5	1.4	2.9
12	.....	2.35	1.6	1.5	1.4	2.05	27	2.1	2.0	1.6	1.5	1.4	3.25
13	.....	2.1	1.65	1.5	1.45	2.25	28	2.0	2.05	1.65	1.5	1.4	3.4
14	.....	2.15	1.7	1.5	1.45	2.25	29	2.15	1.95	1.6	1.4	1.4	3.4
15	.....	2.1	1.7	1.5	1.45	2.3	30	2.0	1.8	1.55	1.45	1.55	3.4
							31	2.15	1.75	.....	1.5	.....	3.45

NOTE.—Ice conditions November 30 to December 31.

Rating table for Frying Pan River at Basalt, Colo., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	68	1.70	118	2.00	187	2.30	272
1.50	83	1.80	139	2.10	214	2.40	302
1.60	99	1.90	162	2.20	242		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908 and one in 1909, and is fairly well defined.

Monthly discharge of Frying Pan River at Basalt, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 19–31	302	187	230	5,930	A.
August	287	128	202	12,000	A.
September	128	83	105	6,250	A.
October	91	68	83.5	5,130	A.
November	83	60	74.0	4,400	A.
December			56.9	3,500	D.
The period				37,200	

NOTE.—Discharge estimated November 30 to December 31 because of ice conditions.

CRYSTAL RIVER NEAR CARBONDALE, COLO.

This station, which was established July 18, 1908, to obtain run-off data valuable because of the great power and storage possibilities on the stream, is located on a single-span highway bridge 150 feet above a section house, at a railroad point known as Sewell on the Redstone branch of the Denver and Rio Grande Railroad. It is about 5 miles above Carbondale. The drainage area of the river below the mouth of Thompson Creek is about 300 square miles.

No important tributaries enter below the station, but Thompson Creek comes in a short distance above.

Several irrigation ditches, with a combined maximum capacity of probably 100 second-feet, divert water above. The following ditches were diverting water above the station on July 18, 1908: Sweet ditch, estimated discharge, 15 second-feet; Grubb ditch, estimated discharge, 12 second-feet; Big Four ditch, estimated discharge, 8 second-feet.

The fall, run-off, and storage possibilities, however, make this essentially a power stream, especially on the upper reaches. Present power plants above the station generate about 1,150 horsepower.

Ice conditions are severe during the winter months and prevent using open channel methods of calculating the discharge.

No change has occurred in either location or datum of the staff gage at the bridge during the maintenance of the station.

Except as affected by ice, the results at this station are satisfactory.

Discharge measurements of Crystal River near Carbondale, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	C. L. Chatfield	51	180	3.00	463
July 18	Freeman and Chatfield	55	198	3.02	514
August 25	C. L. Chatfield	54	160	2.43	253
September 24	do	52	126	1.80	94
October 30	do	53	138	1.95	136
December 3	do	52	119	1.80	101

Daily gage height, in feet, of Crystal River near Carbondale, Colo., for 1908.

[Wm. Sutton and Matt Taylor, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.05	2.15	2.0	1.95	1.7	16	.....	2.7	1.9	2.05	1.8	1.65
2	.....	3.2	2.1	1.9	1.95	1.7	17	.....	2.6	1.85	2.1	1.8	1.9
3	.....	2.85	2.1	1.9	2.0	1.7	18	3.0	2.8	1.85	2.15	1.8	1.7
4	.....	2.75	2.15	1.9	2.0	1.8	19	3.05	.....	1.9	2.15	1.75	1.6
5	.....	2.7	2.05	1.9	2.0	1.9	20	2.95	.....	1.8	2.1	1.7	1.85
6	.....	2.7	2.0	1.9	2.0	1.8	21	2.95	.....	1.8	2.1	1.7	1.9
7	.....	2.7	1.95	1.9	2.0	1.8	22	2.95	.....	1.8	2.1	1.7	2.0
8	.....	2.55	1.9	1.9	2.0	1.75	23	2.85	.....	1.8	2.0	1.7	2.1
9	.....	2.5	2.1	1.9	2.0	1.7	24	2.75	.....	1.8	2.0	1.75	2.15
10	.....	2.45	2.1	1.9	1.95	1.7	25	2.75	.....	2.0	2.0	1.85	2.2
11	.....	2.95	2.15	1.9	1.9	1.6	26	2.7	2.45	2.1	1.9	1.85	2.2
12	.....	2.85	2.1	1.9	1.9	1.6	27	2.8	2.45	2.0	1.9	1.8	2.0
13	.....	2.8	2.0	1.8	1.8	1.6	28	2.75	2.35	2.0	2.0	1.8	1.9
14	.....	2.85	1.95	1.8	1.8	1.5	29	2.75	2.25	2.0	2.05	1.8	1.85
15	.....	2.85	1.9	1.9	1.85	1.45	30	2.8	2.25	2.0	2.05	1.7	1.75
							31	2.85	2.15	.....	1.95	.....	1.7

Rating table for Crystal River near Carbondale, Colo., July 18 to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	50	1.90	121	2.40	245	2.90	451
1.50	61	2.00	141	2.50	278	3.00	503
1.60	73	2.10	164	2.60	315	3.10	559
1.70	87	2.20	189	2.70	357		
1.80	103	2.30	216	2.80	403		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908, and one in 1909, and is well defined between gage heights 1.7 feet and 3.0 feet.

Monthly discharge of Crystal River near Carbondale, Colo., for 1908.[a]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 18–31	531	357	428	11,900	A.
August	617	176	342	21,000	A.
September	176	103	138	8,210	A.
October	176	103	135	8,300	A.
November	141	87	114	6,780	A.
December	189	56	107	6,580	B.
The period	.....	.....	.....	62,800	

[a] These estimates do not include ditch diversion above the gaging station. See description.

GUNNISON RIVER DRAINAGE BASIN.

DESCRIPTION.

Gunnison River is formed in Gunnison County, Colo., by the union of East and Taylor rivers, two streams that have their origin among the snow-covered peaks and on the slopes of the Continental Divide in the northeastern part of the county, descend through narrow mountain valleys, and unite about 12 miles above Gunnison.

From the junction of these rivers the Gunnison flows west and southwest to the point where it enters Grand River at Grand Junction, in the central part of Mesa County, Colo.

The upper course of the river lies through a broad, mountainous valley, but near the mouth of Lake Fork the valley narrows and the river enters Black Canyon of the Gunnison, through which it winds in a tortuous course for 56 miles between granite walls that rise precipitously 3,000 feet above the water's edge. (See Pl. VIII, *A*.) A short distance below the mouth of North Fork, the largest tributary of the river, the canyon walls break abruptly, and the valley is broad and fertile. Below Delta the river enters another narrow canyon, with walls averaging 800 feet in height, and this continues irregularly to Grand Junction, a few tracts of narrow bottom land lying between the channel and the canyon walls.

The soil of the lower valleys is chiefly adobe, and the higher mesas have large content of gravel and sand. Groves of quaking aspen, interspersed with large, open grazing plots, cover broad areas of this plateau region. Forests of pine and aspen occur on the top of the Grand Mesa, with piñon pines and cedars along the foothills. In the valleys chico and sagebrush form the controlling vegetation, except along the streams, which are bordered to some extent by cottonwood, willow, and undergrowth.

The chief tributaries of the Gunnison are Ohio, Tomichi, Lake Fork, and Cimarron creeks, and Smith, North Fork, and Uncompahgre rivers, North Fork being the largest.

North Fork rises in the Huntsman Hills, 20 miles south of Glenwood Springs, flows in a general south and southwesterly course, and unites with the Gunnison about 8 miles west of Hotchkiss. The drainage area is highly mountainous, except for a small portion which lies below Paonia, extreme points reaching an altitude of 13,000 feet. The mesa lands at the lower end of the valley stand 5,500 feet above sea level. The higher peaks are formed of granite rocks, but lower down sedimentary formations occupy at least 80 per cent of the area of the basin. The mountains are forested and the mesa lands are covered with sagebrush. All the tillable lands of the North Fork and its tributaries have been brought under cultivation, and irrigation is practiced to such an extent that the entire flow is needed for existing systems.

Uncompahgre River, the principal tributary of the Gunnison from the south, rises among the snowy peaks of the highly serrated Uncompahgre Mountains and flows a little west of north to its junction with the Gunnison at Delta. The basin embraces a mountainous plateau and valley area of 1,130 square miles, oblong in shape, the width increasing slightly at the lower end. The mountain area occupies but a small part of the basin, but contributes the perennial

waters of the stream. The plateau area is greatest in extent and borders the valley on both sides, the larger Uncompahgre Plateau lying to the southwest. Escarpments are conspicuous features of this plateau. The relief features are terraced mesas flanked by shale buttes and ridges, trenched by deep, narrow canyons. Uncompahgre Valley proper begins at a point near Eldredge siding, on the Denver and Rio Grande Railroad.

The other tributaries of the Gunnison need not here be described. Ohio, Tomichi, Lake Fork, and Cimarron creeks are perennial streams, but almost their entire volume is diverted for irrigation during the growing season, so that very little water reaches the Gunnison except at times of heavy storms or during spring floods.

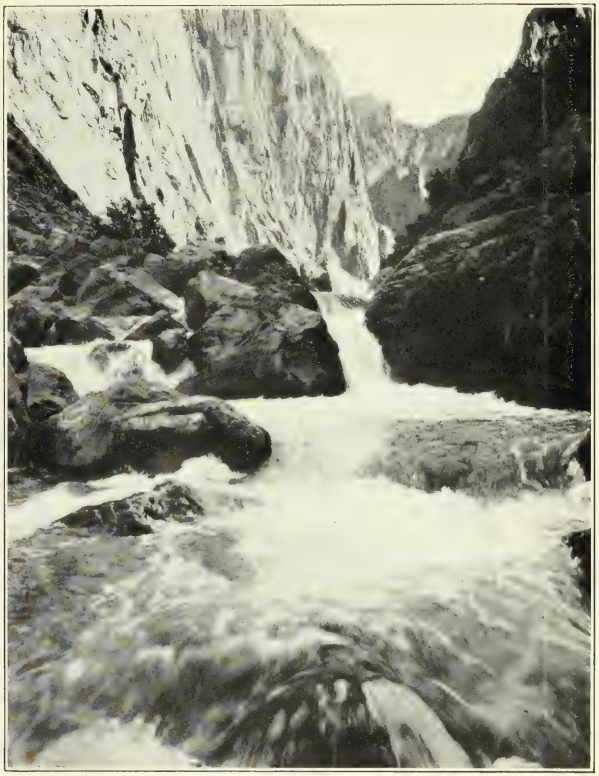
Precipitation records for the Gunnison basin are meager. Those which exist show a range from 9 inches in the plateau region to about 25 inches in the mountains.

The run-off of the Gunnison drainage basin is protected to a large extent by four forest reserves, which have a total area of about 5,700 square miles, of which approximately 3,800 square miles are located within the basin. About 65 per cent of this area is in standing timber, the remainder being classified as sagebrush, barren and burned. Investigation of the headwaters of East River and other tributaries in Gunnison County several years ago showed that many of the hills had been almost entirely denuded of their timber, a discovery to which may be attributed the setting aside of the areas as forest reserves.

Along Gunnison River proper, above the mouth of Lake Fork, a number of ditches divert water for meadow irrigation, and irrigation is extensively practiced in the vicinity of delta. The largest irrigated area in the Gunnison drainage is the Uncompahgre Valley. In addition the lands being irrigated by large private ditches this valley contains about 150,000 acres, which are being reclaimed under the Uncompahgre project of the United States Reclamation Service. The greater part of the water for this land will be diverted from Gunnison River by means of the Gunnison tunnel, which has a capacity of about 1,300 second-feet. The present water rights consume the normal flow of Uncompahgre River, and the Uncompahgre Valley project will divert all the available water from Gunnison River during normal stages.

The country is not adapted for large reservoirs, the meadows having too much fall and the valleys being too narrow, so that construction would be expensive in proportion to reservoir capacity. However, a large number of small reservoirs exist on the Gunnison and its tributaries, which can be advantageously utilized for power.

Power plants at present in operation in this basin develop about 2,200 horsepower, and unutilized possibilities are very great. The



A. TORRENCE FALLS, GUNNISON RIVER CANYON, COLORADO.

B. GUNNISON RIVER FROM GAGING STATION, SHOWING EAST END OF GUNNISON TUNNEL, UNCOMPAHGRE PROJECT, COLORADO.

fall along some of the streams is heavy, averaging 50 to 150 feet to the mile. Along the Uncompahgre, from its source to the 8,000-foot contour, the fall is almost 300 feet to the mile. At the present time the waters in this basin are being used chiefly for domestic purposes and irrigation. By utilizing all the available storage it would theoretically be possible to develop about 200,000 horsepower. Along the South canal of the United States Reclamation Service, which receives the water from the Gunnison tunnel and carries it into Uncompaghre River, a series of drops will make possible the development of from 5,000 to 10,000 horsepower.

But two gaging stations were maintained previous to 1900, but since that year a number have been established and discontinued. The records, as a rule, cover about three-year periods, and show that 1904 was the driest and 1907 the wettest year. By comparison with other drainage basins adjacent to the Gunnison, however, it is evident that 1902 was a drier year than 1904.

GUNNISON RIVER AT RIVER PORTAL, COLO.[a]

This station, which was established April 7, 1905, to determine the water supply available for Gunnison tunnel for the United States Reclamation Service, replaced the station located at Cimarron, about 12 miles above. It is about 100 yards above the portal of Gunnison tunnel (Pl. VIII, *B*) and is about 21 miles northeast of Montrose. The data are valuable also because of the great power possibilities on the upper river.

The station is about 8 miles below the mouth of Crystal Creek, and is above North Fork and Uncompahgre River, the two most important tributaries.

A number of small ditches divert water for meadow irrigation above the station. The largest diversion along the river, and also in Colorado, is the recently completed Gunnison tunnel, with a capacity of about 1,300 second-feet, which diverts the water from the Gunnison into the Uncompahgre Valley, where it will be used for irrigation.[b]

Ice covers the river for about four months each year and attains a thickness of 1 to 2 feet. No winter records of discharge have been obtained.

Neither the location nor datum of the staff gage has been changed during the maintenance of the station. Discharge measurements are made from a cable a few feet downstream from the gage.

Fairly good results have been obtained at this station during the open seasons.

This station is maintained under the direction of the United States Reclamation Service.

[a] This station was referred to in previous reports as at east portal of Gunnison tunnel.
[b] The Gunnison tunnel and Uncompahgre project are described in the report of the United States Reclamation Service.

Discharge measurements of Gunnison River at River Portal, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 7	T. I. Phelps	.....	906	5.62	649
March 8	do	.....	880	5.50	576
March 14	do	.....	855	5.35	480
Do	do	.....	847	5.27	463
April 12	do	170	1,500	9.55	4,160
April 15	do	172	1,530	9.70	4,420
April 22	do	155	1,210	7.68	1,860
May 20	do	180	1,740	10.85	5,470
June 11	do	191	1,930	11.90	8,700
June 17	do	204	2,340	13.55	11,400
July 8	do	192	1,990	12.20	8,960
July 12	do	179	1,770	11.10	6,780
July 16	do	163	1,710	10.40	5,550
August 7	do	.....	1,280	8.25	2,880
August 23	do	.....	1,050	7.18	1,710
November 13	do	.....	704	5.10	429
1908.					
April 6	T. I. Phelps	148	939	6.32	1,330
April 18	do	160	1,260	8.48	2,980
April 28	do	153	1,090	7.23	2,170
June 17	do	183	1,700	11.00	6,630
July 22	do	149	996	6.80	1,460

Daily gage height, in feet, of Gunnison River at River Portal, Colo., for 1907 and 1908.

[T. I. Phelps, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	.....	6.30	7.88	9.80	13.45	8.60	7.25	6.20	6.00
2	.....	6.30	7.75	10.20	13.30	8.70	7.05	6.20	6.00
3	.....	6.60	7.75	11.70	12.90	9.05	6.90	6.20	5.95
4	.....	6.85	7.65	11.95	13.00	8.75	6.80	6.20	5.88
5	5.60	7.00	7.55	12.45	12.95	8.65	6.75	6.15	5.85
6	5.68	6.90	7.65	12.95	12.65	8.35	6.70	6.15	5.90
7	5.65	6.65	7.70	12.90	12.45	8.25	6.70	6.35	5.90
8	5.55	6.60	7.65	12.75	12.10	8.20	6.65	6.45	5.90
9	5.55	6.85	7.68	12.50	11.70	8.10	6.60	6.50	5.90
10	5.50	7.40	7.70	12.00	11.50	8.05	6.60	6.35	5.90
11	5.50	8.48	8.10	11.90	11.45	7.85	6.45	6.30	5.90
12	5.55	9.38	8.68	12.40	11.00	7.80	6.40	6.20	5.58
13	5.50	9.52	8.75	12.85	10.80	7.85	6.40	6.20	5.15
14	5.35	9.40	8.45	13.10	11.25	8.25	6.50	6.15	5.30
15	5.30	9.62	8.20	13.45	11.10	8.10	6.80	6.10	5.40
16	5.40	9.48	8.20	13.40	10.45	7.95	6.80	6.05	5.85
17	5.85	9.92	8.60	13.55	10.10	7.70	6.55	6.00	5.80
18	6.30	8.55	9.05	13.45	9.75	7.45	6.50	6.00	5.70
19	6.90	8.30	9.85	13.50	9.55	7.55	6.50	6.00	5.80
20	7.50	7.95	11.05	13.30	9.40	7.65	6.50	6.00	5.65
21	7.50	7.60	12.10	12.85	9.45	7.50	6.50	6.00	5.50
22	7.30	7.66	12.30	12.55	9.40	7.35	6.40	.....	5.30
23	7.00	7.69	12.55	12.50	9.30	7.15	6.30	.....	5.20
24	6.85	7.65	12.05	12.70	9.20	6.95	6.30	.....	.....
25	6.80	7.85	11.35	12.95	9.25	7.20	6.20	6.20	.....
26	6.85	7.88	10.85	13.15	9.75	7.20	6.25	6.10	.....
27	6.75	7.88	10.60	13.20	10.20	7.10	6.25	6.10	.....
28	6.60	7.92	10.40	13.05	9.70	7.20	6.25	6.10	.....
29	6.35	8.10	10.20	13.20	9.25	7.20	6.20	6.10	.....
30	6.20	7.98	10.15	13.40	8.95	7.30	6.20	6.05	.....
31	6.30	.....	10.05	.....	8.70	7.60	.....	6.00	.....

Daily gage height, in feet, of Gunnison River at River Portal, Colo., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	.....	5.9	7.25	8.85	9.0	7.5	6.1	5.7	5.6
2	.....	6.0	7.55	9.05	8.65	8.0	6.0	5.7	5.6
3	.....	6.0	8.2	9.15	8.6	8.0	5.9	5.7	5.5
4	.....	6.2	7.9	9.55	.....	7.5	5.7	5.7	5.5
5	.....	6.25	7.55	9.7	8.5	7.3	5.6	5.6	5.5
6	.....	6.4	7.6	9.7	8.4	7.3	5.6	5.6	5.5
7	.....	6.3	7.7	9.4	8.2	7.0	5.6	5.6	5.5
8	.....	6.3	8.05	9.15	8.2	7.0	5.6	5.6	5.4
9	.....	6.3	8.45	9.25	8.0	6.8	5.7	5.6	5.4
10	.....	6.4	8.35	10.25	7.9	6.7	5.6	5.6	5.4
11	.....	6.75	7.95	11.1	8.0	7.3	5.6	5.6	5.4
12	.....	6.95	7.9	10.9	7.9	7.3	5.9	5.6	5.3
13	.....	7.3	7.7	10.8	7.85	7.1	.....	5.6	5.3
14	.....	7.85	7.7	11.0	7.75	.....	5.8	5.6	.....
15	.....	8.35	7.65	11.0	.....	6.9	5.8	5.6	.....
16	.....	8.45	7.6	10.8	7.95	6.8	5.8	5.6	.....
17	.....	8.4	7.9	11.1	7.75	7.1	5.7	5.6	.....
18	.....	8.5	8.25	10.7	7.5	7.1	5.7	5.6	.....
19	.....	8.35	8.7	9.85	7.2	7.4	5.6	5.6	.....
20	.....	8.2	9.2	9.25	7.05	7.2	5.6	5.7	.....
21	.....	8.25	8.85	9.45	6.95	7.1	5.6	5.7	.....
22	.....	8.5	8.9	9.7	6.82	6.9	.....	5.7	.....
23	.....	8.5	8.7	10.1	6.7	6.7	5.6	5.6	.....
24	.....	8.2	8.65	9.95	6.72	6.6	5.6	5.6	.....
25	.....	7.9	8.55	10.1	6.75	6.5	5.6	5.6	.....
26	.....	7.5	8.5	10.1	.....	6.5	5.7	5.5	.....
27	.....	7.25	8.5	.....	6.6	6.4	5.8	5.5	.....
28	.....	7.25	8.2	.....	6.6	6.4	5.8	5.5	.....
29	.....	7.2	7.95	.....	6.55	6.3	5.7	5.5	.....
30	.....	7.1	7.95	.....	6.6	6.2	5.7	5.5	.....
31	.....	.....	8.4	.....	6.8	6.1	.....	5.6	.....

Rating table for Gunnison River at River Portal, Colo., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.10	395	6.30	1,090	7.50	2,080	9.40	4,035
5.20	435	6.40	1,165	7.60	2,170	9.60	4,270
5.30	480	6.50	1,240	7.70	2,260	9.80	4,540
5.40	525	6.60	1,315	7.80	2,350	10.00	4,850
5.50	575	6.70	1,395	7.90	2,445	10.20	5,170
5.60	630	6.80	1,475	8.00	2,540	10.40	5,510
5.70	685	6.90	1,555	8.20	2,730	10.60	5,860
5.80	745	7.00	1,640	8.40	2,930	10.80	6,230
5.90	810	7.10	1,725	8.60	3,140	11.00	6,620
6.00	880	7.20	1,810	8.80	3,360	12.00	8,830
6.10	950	7.30	1,900	9.00	3,580	13.00	11,280
6.20	1,020	7.40	1,990	9.20	3,805	14.00	13,880

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made in 1907 and 1908 and is fairly well defined. Owing to shifting conditions of flow it may not be strictly applicable at times during the above period.

Monthly discharge of Gunnison River at River Portal, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 5–31	2,080	480	1,060	56,800	B.
April	4,720	1,090	2,500	149,000	B.
May	10,200	2,120	4,400	271,000	B.
June	12,700	4,540	10,500	625,000	B.
July	12,400	3,250	6,620	407,000	A.
August	3,640	1,600	2,400	148,000	A.
September	1,860	1,020	1,310	78,000	B.
October	1,240	880	986	60,600	B.
November 1–23	880	415	703	32,100	B.
The period				1,830,000	
1908.					
April	3,030	810	1,940	115,000	C.
May	3,800	1,860	2,690	165,000	C.
June	6,830	3,420	4,880	290,000	B.
July	3,580	1,280	2,170	133,000	B.
August	2,540	950	1,630	100,000	C.
September	950	630	698	41,500	C.
October	685	575	634	39,000	C.
November 1–13	630	480	553	14,300	C.
The period				898,000	

UNCOMPAHGRE RIVER NEAR OURAY, COLO.

During January, February, and March, 1908, records of flow of Uncompahgre River were taken at the power plant of the Ouray Electric Power and Light Company, about 1 mile south of Ouray, Colo. These records were taken by Wheeler & Whinnerah, in the interests of the company, and they have furnished them to the United States Geological Survey for publication.

A dam built of plank, with a weir opening 10 feet wide, was used, and the depth of the water over the weir in inches was measured at a point about 6 feet back from the crest. The discharge data were computed practically on the basis of a standard Francis weir with end contractions.

Daily discharge, in second-feet, of Uncompahgre River near Ouray, Colo., for 1908.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1		12.2	a 13.4	11	15.4	14.5	15.1	21	15.1	13.1	
2		14.3	14.5	12	a 14.6	14.3	13.9	22	a 15.1	13.9	
3		13.5	12.8	13	13.9	13.1	19.6	23	15.1	15.8	
4		13.9	17.1	14	a 13.6	12.8	21.3	24	14.5	13.5	
5		14.9	13.3	15	13.3	12.9	a 30.8	25	a 14.0	12.8	
6		13.9	12.8	16	13.1	a 12.9	40.4	26	a 13.4	15.4	
7	13.7	17.5	14.3	17	12.9	a 12.8	26.4	27	12.9	15.4	
8	a 15.0	17.1	14.7	18	a 13.4	12.8		28	13.1	14.7	
9	16.2	13.1	12.6	19	13.9	13.5		29	14.5	12.4	
10	a 15.8	14.1	14.3	20	13.5	12.8		30	17.3		
								31	15.1		

a Interpolated.

Monthly discharge of Uncompahgre River near Ouray, Colo., for 1908.

[Drainage area, 45 square miles.]

Month.	Discharge in second-feet.		Run-off.	
	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January 7–31	14.3	0.318	0.29	709
February	13.9	.309	.33	800
March 1–17	18.1	.402	.25	610

UNCOMPAHGRE RIVER AT FORT CRAWFORD, COLO.

This station, which was established October 2, 1907, to obtain information concerning the water supply above the principal diversions in the Uncompahgre Valley, replaces the station near Colona, which was established August 10, 1903. Its present location is at a highway bridge across Uncompahgre River about one-half mile west of Port Crawford, in sec. 36, T. 48 N., R. 9 W. Records were discontinued at the end of the season of 1908.

The station is located just below the mouth of Horsefly Creek. A number of large private irrigation ditches divert water above this station. Existing power plants generate about 1,800 horsepower. Opportunity for extended power development is found on the headwaters.

Thick ice forms along the edges of the river during the winter months. The channel remains open at the station, but slush ice affects the accuracy of the results at times. The channel scours during high stages and silts during periods of low water.

On June 21, 1908, the rod gage, which was established October 2, 1907, was washed out. On July 7, 1908, a temporary chain gage was installed. The zero of this gage was placed 1.95 feet below the zero of the rod gage. On July 23, 1908, a permanent rod gage was installed, the zero of which corresponds to 0.70 foot on the first rod gage, and to 2.65 feet on the chain gage. Gage readings for 1908 have been referred to the datum of the last gage.

Records during June and July, 1908, are unsatisfactory, because of the constant shifting of the channel.

This station was maintained under the supervision of the United States Reclamation Service.

Discharge measurements of Uncompahgre River at Fort Crawford, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 28	L. J. Foster	45	63	1.70	104
April 18	do	48	87	2.30	244
May 1	do	47	82	2.20	216
May 16	do	46	73	1.96	156
June 4	do	49	104	2.78	451
June 17	do	61	216	3.30	1,030
July 2	do	58	111	[a] 2.64	524
July 10	do	56.5	100	2.40	477
July 21	do	57	90	2.00	373
August 6	do	58	91	2.60	386
September 2	do	55	40	1.80	116
September 23	do	53	23	1.50	52

[a] Gage height referred to chain gage from existing reference points. Later reduced to rod gage. See note.

NOTE.—Gage heights of measurements at this station made prior to July 23, 1908, have been reduced to datum of gage established on that date.

Daily gage height, in feet, of Uncompahgre River at Fort Crawford, Colo., for 1908.

[Roy Humphrey, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.85	2.15	2.75		2.8	2.0	1.6	1.8
2		1.9	2.1	2.8	2.65	2.9	1.95	1.65	1.8
3		1.9	2.2	2.75		2.9	1.9	1.7	1.8
4		1.9	2.35	2.85		3.0	1.92	1.7	1.8
5		1.95	2.3	2.9		2.65	1.85	1.7	1.7
6		1.9	2.3	2.8		2.8	1.75	1.7	1.7
7		1.95	2.4	2.7	[a] 2.7	2.7	1.65	1.7	1.7
8		1.95	2.35	2.8	2.6	2.65	1.6	1.7	1.7
9		2.0	2.3	2.85	2.45	2.5	1.55	1.7	1.7
10		2.05	2.3	3.3	2.4	2.6	1.55	1.7	1.7
11		2.1	2.4	3.9	2.6	2.95	1.6	1.7	1.7
12		2.25	2.3	3.6	2.5	2.75	1.6	1.7	1.7
13		2.25	2.4	3.3	2.6	2.65	1.6	1.7	1.7
14		2.35	2.2	3.3	2.6	2.8	1.6	1.8	1.6
15		2.5	2.15	3.3	2.65	2.85	1.6	1.8	1.6
16		2.55	2.15	3.2	2.7	2.65	1.6	1.8	1.6
17		2.5	2.15	3.0	2.75	2.9	1.6	1.8	1.5
18		2.4	2.35	2.9	2.5	2.8	1.6	1.8	1.5
19		2.4	2.65	2.9	2.2	2.75	1.6	1.8	1.5
20		2.55	2.7	2.85	2.15	2.95	1.6	1.8	1.5
21		2.6	2.8	[b]	2.05	2.65	1.6	1.9	1.5
22		2.55	2.9		2.05	2.65	1.6	1.9	1.5
23		2.65	2.7		[c] 2.0	2.6	1.6	1.9	1.5
24		2.7	2.65		1.95	2.5	1.6	1.9	1.5
25		2.6	2.4		1.9	2.5	1.65	1.9	1.5
26		2.45	2.3		1.95	2.5	1.65	1.9	1.5
27		2.35	2.3		1.85	2.5	1.6	1.9	1.4
28	1.7	2.35	2.35		1.85	2.4	1.6	1.85	1.4
29		2.4	2.45		1.85	2.3	1.6	1.8	1.4
30		1.9	2.6		2.55	2.0	1.6	1.8	1.4
31			2.6		2.65	2.0		1.8	

[a] Temporary gage established. [b] Gage washed out. [c] Permanent gage established.

NOTE.—Gage heights from March 28 to July 22 have been reduced to datum of gage established July 23, 1908.

Rating table for Uncompahgre River at Fort Crawford, Colo., for March 28 to June 10 and August 1 to November 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	39	1.90	138	2.40	292	2.90	540
1.50	55	2.00	164	2.50	332	3.00	603
1.60	73	2.10	192	2.60	377	3.10	669
1.70	93	2.20	222	2.70	427	3.20	738
1.80	115	2.30	255	2.80	481	3.30	810

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 8 discharge measurements made during 1908, and is well defined.

JUNE 11 TO JUNE 20 AND JULY 12 TO JULY 31, 1908.

[The indirect method for shifting channels used.]

Daily discharge, in second-feet, of Uncompahgre River at Fort Crawford, Colo., June 11 to June 20 and July 1 to July 31, 1908.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		530	11	1,340	610	21		400
2		530	12	1,130	560	22		370
3		550	13	900	635	23		320
4		570	14	930	645	24		300
5		590	15	965	685	25		240
6		610	16	910	740	26		240
7		630	17	800	800	27		185
8		580	18	720	620	28		175
9		495	19	720	455	29		160
10		475	20	680	450	30		400
						31		425

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Uncompahgre River at Fort Crawford, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	427	126	253	15,100	A.
May	540	192	299	18,400	A.
June 1–20	1,340	427	712	28,200	C.
July	800	160	483	29,700	C.
August	603	164	414	25,500	A.
September	164	64	86.3	5,140	B.
October	138	73	110	6,760	B.
November	115	39	74.1	4,410	B.
The period				133,000	

NOTE.—Indirect method for shifting channel used for June 11–20 and July 2–31.

UNCOMPAHGRE RIVER AT MONTROSE, COLO.

This station, which was established April 22, 1903, to obtain for the United States Reclamation Service definite information concerning the amount of water carried by the Uncompahgre, is located at the iron highway bridge just west of Montrose and one-fourth mile west of the Denver and Rio Grande Railroad. The data are of value also in connection with power development.

The station is about 2 miles above Happy Canyon Creek and is also above Cedar and Spring creeks. Large irrigation ditches divert water between this station and that at Fort Crawford. Existing water rights control the normal flow of this river for irrigation. Above these diversions, however, opportunities exist for storage and power development. Established plants generate about 1,800 horsepower. Open-channel conditions prevail at this station, although thick ice usually forms along the edges. Slush and anchor ice sometimes influence the accuracy of the results. The flow is controlled during the irrigation season by the large diversions above. The flow at this point will also be affected by the inflow from the south canal of the United States Reclamation Service when that is completed.

Neither the location nor the datum of the staff gage, which is 20 feet upstream from the bridge, has been changed during the maintenance of the station.

Results obtained are good except during winter periods and extreme low water.

This station is maintained under the supervision of the United States Reclamation Service.

Discharge measurements of Uncompahgre River at Montrose, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 9	E. F. Kriegsman	30	46	2.40	106
May 14	do	25	27	1.79	31
June 3	H. J. Kesner	34	70	3.32	345
June 17	Kriegsman and Kesner	54	135	4.40	841
July 1	H. J. Kesner	90	244	5.67	1,520
1908.					
May 6	L. J. Foster	24	29.7	2.01	44
June 18	do	46	97	3.47	428
June 26	do	55	136	4.42	728
July 17	do	29.3	53	2.77	169
August 7	do	30.5	58	2.94	194
September 3	do	27	28	1.98	31
September 10	do	16	12	1.50	5
September 24	do	23	24.8	1.83	12

Daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1907 and 1908.

[Thomas Reeves, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.											
1	2.38	2.22	2.2	2.15	1.82	1.9	5.3	2.85	2.22	1.5	1.8
2	2.25	2.3	2.18	1.8	1.28	2.28	5.25	3.35	2.15	1.55	1.8
3	2.05	2.3	2.1	1.85	2.22	3.3	5.05	4.15	2.08	1.5	1.8
4	2.3	2.3	2.22	1.85	2.6	3.32	4.75	3.75	1.98	1.5	1.78
5	2.25	2.45	2.08	2.1	2.72	3.35	5.35	3.32	1.98	1.55	1.45
6	2.3	2.35	2.05	1.98	2.6	3.45	5.25	3.0	1.95	1.5	1.7
7	2.28	2.3	2.05	1.9	2.05	3.55	5.0	2.9	1.92	1.52	1.72
8	2.3	2.3	2.0	2.05	2.4	3.55	4.9	2.7	1.92	1.52	1.75
9	2.25	2.3	2.15	2.2	2.4	3.55	4.75	2.5	1.98	1.5	1.75
10	2.25	2.2	2.0	2.58	2.1	3.25	4.9	2.5	1.92	1.55	1.75
11	2.2	2.05	2.05	2.9	2.4	3.25	4.95	2.38	1.9	1.6	1.55
12	2.12	2.2	2.1	2.78	2.35	3.55	4.3	2.25	1.95	1.65	1.5
13	2.12	2.25	2.0	2.7	2.0	3.75	4.5	2.6	1.85	1.7	1.52
14	2.25	2.2	1.95	2.55	1.88	3.85	4.9	3.0	1.92	1.7	1.75
15	2.25	2.25	1.95	2.48	1.55	3.85	4.35	2.88	2.05	1.7	1.78
16	2.0	2.18	2.02	2.2	1.75	3.85	4.2	2.85	1.85	1.7	1.8
17	2.22	2.15	2.05	1.95	2.08	4.15	4.85	2.6	1.95	1.7	1.98
18	2.2	2.15	2.05	1.88	1.9	4.25	4.2	2.6	1.92	1.7	1.95
19	2.2	2.12	2.2	1.55	2.45	3.8	3.25	2.85	1.85	1.7	1.95
20	2.2	2.1	2.25	1.68	2.95	3.7	3.15	2.85	1.82	1.7	1.92
21	2.2	2.05	2.5	1.68	3.3	3.55	3.55	2.75	1.78	1.7	1.95
22	2.3	2.1	2.38	1.58	3.18	3.25	3.45	2.55	1.72	1.7	2.0
23	2.2	2.1	2.18	1.75	3.4	3.3	3.35	2.58	1.77	1.7	2.22
24	2.12	2.2	2.25	2.38	2.78	4.2	3.2	2.62	1.75	1.7	2.22
25	2.0	2.2	2.05	2.4	2.2	4.08	3.25	2.62	1.78	1.9	1.95
26	2.2	2.3	2.02	2.35	1.95	4.4	3.4	2.7	1.75	1.8	1.92
27	2.05	2.15	1.98	2.05	1.88	4.8	3.8	2.48	1.62	1.8	1.95
28	2.1	2.25	2.0	1.95	1.82	4.85	3.55	2.35	1.6	1.8	1.92
29	2.05	.....	1.88	1.9	1.82	5.25	3.45	2.2	1.55	1.78	1.9
30	2.22	.....	2.25	1.95	2.1	5.45	3.1	2.3	1.5	1.75	1.88
31	2.25	.....	2.15	.....	2.05	.....	2.95	2.25	.....	1.8	.....
1908.											
1	2.20	2.10	2.15	1.40	2.45	2.00	3.65	2.80	1.65	1.87	2.40
2	2.15	2.10	2.2	1.37	2.35	2.00	2.80	3.85	1.75	1.80	2.35
3	2.20	2.10	2.35	1.55	2.30	2.37	2.75	3.10	2.05	2.00	2.40
4	2.22	2.05	2.35	1.68	2.20	2.25	2.65	2.75	2.05	1.95	2.42
5	2.13	2.05	2.25	1.57	2.35	2.15	2.90	2.50	1.90	1.85	2.50
6	2.10	1.95	2.2	1.65	2.00	2.15	2.92	3.28	1.62	1.88	2.53
7	2.18	2.10	2.2	1.75	2.07	2.38	2.85	3.05	1.60	1.95	2.50
8	2.05	2.20	2.1	1.65	2.20	2.25	2.80	2.78	1.50	1.88	2.45
9	2.17	2.15	2.15	1.75	2.05	2.37	2.90	2.18	1.65	1.95	2.50
10	2.15	1.95	2.08	1.85	2.05	3.27	2.85	2.22	1.68	1.95	2.42
11	2.15	2.15	2.17	1.90	2.00	3.70	2.80	3.32	1.50	1.87	2.50
12	2.10	2.05	1.95	1.78	1.98	3.22	2.85	2.95	1.50	1.93	2.50
13	2.08	2.15	2.3	1.85	1.95	3.15	2.80	2.52	1.50	1.90	2.48
14	2.07	2.15	2.35	2.40	1.92	3.33	2.80	3.10	1.58	1.90	2.45
15	2.22	2.05	2.35	2.55	2.00	3.12	3.05	2.80	1.65	1.90	2.40
16	2.22	2.08	2.42	2.47	1.95	3.55	2.78	2.65	1.70	1.92	2.37
17	2.05	2.10	2.62	2.40	2.25	3.90	2.82	3.08	1.65	2.25	2.35
18	2.05	2.10	2.5	2.37	2.45	3.23	2.65	3.12	1.65	2.30	2.40
19	2.10	2.15	2.45	2.40	2.20	2.35	2.48	3.25	1.68	2.35	2.35
20	2.15	2.05	2.33	2.23	2.00	2.23	2.45	3.50	1.65	2.35	2.40
21	2.15	2.08	2.28	2.15	2.00	2.78	2.42	3.25	1.75	2.30	2.45
22	2.20	2.05	2.3	2.50	2.00	3.15	2.40	3.15	1.85	2.40	2.40
23	2.10	2.05	2.25	2.42	2.15	3.10	2.50	2.75	1.75	2.30	2.50
24	2.15	2.10	2.22	2.45	2.05	3.00	2.35	2.75	1.75	2.30	2.48
25	2.15	2.07	2.25	2.13	2.05	3.15	2.35	2.58	1.92	2.37	2.40
26	2.05	2.08	2.15	2.05	2.05	4.27	2.45	2.40	2.10	2.33	2.47
27	1.95	2.15	2.05	2.05	2.10	3.80	2.50	2.02	1.95	2.37	2.50
28	1.95	2.15	1.95	2.15	2.00	4.05	2.25	1.98	2.00	2.40	2.50
29	2.10	2.22	1.98	2.22	2.05	3.55	2.65	1.65	1.85	2.40	2.40
30	2.05	.....	1.92	2.30	1.92	3.65	2.50	1.75	1.95	2.40	2.35
31	2.05	.....	1.8	.....	2.40	.....	2.75	1.55	.....	2.40	.....

Rating tables for Uncompahgre River at Montrose, Colo.

JANUARY 1, 1907, TO JUNE 25, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	6	2.40	104	3.50	425	4.60	950
1.40	9	2.50	122	3.60	470	4.70	1,000
1.50	12	2.60	143	3.70	515	4.80	1,050
1.60	16	2.70	165	3.80	560	4.90	1,100
1.70	22	2.80	187	3.90	605	5.00	1,150
1.80	28	2.90	212	4.00	650	5.20	1,255
1.90	36	3.00	240	4.10	700	5.40	1,365
2.00	46	3.10	271	4.20	750	5.50	1,420
2.10	58	3.20	305	4.30	800		
2.20	72	3.30	342	4.40	850		
2.30	88	3.40	382	4.50	900		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on 7 discharge measurements made during 1907 and 1908 and is well defined between gage heights 1.8 feet and 5.5 feet.

JUNE 26, 1908, TO NOVEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	5	2.20	60	2.90	196	3.60	402
1.60	6	2.30	75	3.00	222	3.70	437
1.70	8	2.40	90	3.10	249	3.80	472
1.80	11	2.50	107	3.20	277	3.90	510
1.90	20	2.60	127	3.30	306	4.00	548
2.00	32	2.70	148	3.40	338	4.10	588
2.10	45	2.80	170	3.50	370		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on 6 discharge measurements made in 1908, and is well defined between gage heights 2.0 feet and 4.1 feet. Below 2.0 feet it is somewhat poorly defined.

Monthly discharge of Uncompahgre River at Montrose, Colo., for 1907 and 1908.

[Drainage area, 565 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	101	46	72.3	0.128	0.15	4,450	C.
February	113	52	75.1	.133	.14	4,170	C.
March	122	34	60.5	.107	.12	3,720	B.
April	212	14	69.4	.123	.14	4,130	B.
May	382	6	102	.181	.21	6,270	B.
June	1,390	36	569	1.01	1.13	33,900	A.
July	1,340	226	769	1.36	1.57	47,300	A.
August	725	72	195	.345	.40	12,000	A.
September	75	12	35.6	.063	.07	2,120	C.
October	36	12	20.2	.036	.04	1,240	D.
November	75	10	33.0	.058	.06	1,960	C.
The period						121,000	
1908.							
January	75	41	60.9	.108	.12	3,740	C.
February	75	41	57.8	.102	.11	3,320	C.
March	147	28	76.8	.136	.16	4,720	B.
April	132	8	60.7	.107	.12	3,610	B.
May	113	38	61.9	.110	.13	3,810	B.
June	661	46	269	.476	.53	16,000	B.
July	420	68	153	.271	.31	9,410	A.
August	491	5.5	178	.315	.36	10,900	A.
September	45	5	14.0	.025	.03	833	D.
October	90	11	50.7	.090	.10	3,120	C.
November	113	82	96.4	.171	.19	5,740	C.
The period						65,200	

UNCOMPAHGRE RIVER NEAR DELTA, COLO.

This station was established April 29, 1903, at a highway bridge one-fourth mile above the Denver and Rio Grande Railroad bridge. On November 17, 1903, it was removed to the Denver and Rio Grande Railroad bridge, one-fourth mile northwest of the Denver and Rio Grande depot. The vertical gage at this bridge was read until April 21, 1904, when an inclined gage was installed on the right bank near the bridge. The gage was read until November, 1906, when a staff gage was installed at the present location—the second highway bridge 2 miles south of Delta. Observations were not begun at this gage until April 21, 1907.

During normal stages the flow of the river at this point is nearly all seepage water from the irrigation ditches above. The station is important because it shows the seepage during low stages, and the storage possibility during high stages.

The station is located near the junction of the Uncompahgre with the Gunnison and is below all tributaries and diversions. During the irrigation season the ditches consume all the normal flow. Opportunities for power and storage development, however, are found on the headwaters of the river.

Results are probably not materially affected by ice conditions, as ice does not form very thick, except along the edges of the stream. Slush ice frequently occurs.

There is no determined relation between the datum of the last established gage and the several earlier gages, and the gage used from April 22, 1904 to November, 1906, is at a different datum from the previous gage.

Records obtained at this station are good except during extremely low stages.

This station is maintained under the supervision of the United States Reclamation Service.

Discharge measurements of Uncompahgre River near Delta, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	E. F. Kriegsman	47	97	2.39	259
May 10	do	15	28	1.38	10
June 5	H. J. Kesner	44	96	2.57	308
June 12	do	42	80	2.14	166
June 20	Kriegsman and Kesner	44	102	2.53	316
June 28	H. J. Kesner	49	138	3.15	527
July 5	do	49	180	3.93	1,040
August 30	L. J. Foster	43	81	2.00	130
October 16	do	27	56	1.75	63
1908.					
April 8	L. J. Foster	20	37	1.55	25.6
April 24	do	20	36	1.50	17.6
May 25	do			1.25	0
June 29	do	51	102	2.50	257
July 31	do	25	45	1.60	39
September 9	do	20	35	1.45	12.3

Daily gage height, in feet, of Uncompahgre River near Delta, Colo., for 1907 and 1908.

[W. J. Lance, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.											
1					1.35	1.4	4.05	2.05	2.0	1.75	1.95
2					1.4	1.4	4.05	2.0	2.0	1.75	1.9
3					1.4	1.75	3.7	2.8	1.85	1.7	2.15
4					1.3	2.75	3.75	2.6	1.7	1.7	2.1
5					1.3	2.5	3.75	2.45	1.7	1.7	2.1
6					1.3	2.75	4.0	2.4	1.7	1.7	2.05
7					1.3	2.75	3.85	2.25	1.7	2.15	2.1
8					1.3	2.8	3.65	2.2	1.7	2.15	2.15
9					1.3	2.7	3.45	2.0	1.7	1.8	2.0
10					1.3	2.7	3.4	2.0	1.7	1.75	1.95
11					1.3	2.75	3.45	1.8	1.7	1.7	1.85
12					1.35	2.5	3.3	1.8	1.7	1.75	1.75
13					1.6	2.55	3.25	2.15	1.6	1.75	1.75
14					1.5	2.55	3.25	2.55	1.6	1.7	1.8
15					1.4	2.55	3.45	2.35	1.8	1.7	1.85
16					1.4	2.65	3.0	2.2	1.95	1.85	2.0
17					1.35	2.75	2.65	2.0	2.0	1.9	2.3
18					1.3	2.85	2.2	1.95	1.8	1.9	2.2
19					1.65	2.7	1.9	2.3	1.8	1.85	1.95
20					1.85	2.65	2.0	2.65	1.8	1.8	2.05
21				1.7	2.2	2.5	2.1	2.55	1.8	1.85	2.0
22				1.4	2.6	2.4	2.0	2.4	1.8	1.9	1.95
23				1.5	2.7	2.15	2.1	2.1	1.7	1.8	2.15
24				1.5	2.6	2.3	2.1	2.1	1.7	1.8	2.5
25				1.5	2.4	2.75	2.25	2.5	1.75	1.95	2.25
26				1.45	2.0	3.2	2.35	2.6	1.8	1.9	2.15
27				1.4	1.75	3.3	2.7	2.0	1.85	1.8	2.05
28				1.4	1.6	3.45	2.65	2.0	1.85	1.75	2.0
29				1.45	1.6	3.55	2.4	2.0	1.8	1.75	2.0
30				1.35	1.6	3.80	2.25	2.0	1.7	1.8	2.15
31				.....	1.45	.....	2.05	2.0	.....	1.8	.....
1908.[a]											
1	2.1	2.0	2.3	1.55	1.3	1.2	1.95	1.5	1.3	1.35	1.9
2	2.15	2.0	2.2	1.5	1.4	1.2	1.6	2.2	1.4	1.5	1.8
3	2.15	2.0	2.0	1.5	1.45	1.2	1.5	1.9	1.3	1.5	1.8
4	2.1	2.0	2.0	1.5	1.45	1.15	1.5	1.7	1.3	1.5	1.8
5	2.0	2.0	2.0	1.5	1.4	1.05	1.4	1.5	1.3	1.55	1.85
6	2.1	2.0	2.0	1.5	1.4	1.1	1.45	1.85	1.3	1.6	2.0
7	2.1	2.0	2.0	1.65	1.3	1.1	1.3	2.15	1.4	1.6	2.0
8	2.05	2.0	2.0	1.6	1.3	1.1	1.35	1.65	1.5	1.6	2.0
9	2.05	2.0	2.0	1.55	1.3	1.2	1.3	1.5	1.5	1.6	2.0
10	2.05	2.0	2.0	1.4	1.3	1.6	1.3	1.6	1.5	1.5	2.0
11	2.05	2.0	2.0	1.35	1.3	2.0	1.35	3.05	1.4	1.5	2.0
12	2.1	2.0	2.05	1.4	1.0	2.0	1.35	2.5	1.4	1.5	2.0
13	2.15	2.0	2.05	1.4	.95	1.65	1.35	1.8	1.5	1.5	2.0
14	2.2	2.0	2.05	1.4	1.1	1.75	1.3	2.25	1.5	1.5	2.0
15	2.15	2.0	2.0	1.4	1.3	1.9	1.5	2.15	1.5	1.5	2.0
16	2.1	2.0	2.0	1.6	1.3	2.0	1.4	1.95	1.5	1.55	1.9
17	2.3	1.9	2.05	1.5	1.3	2.15	1.35	2.0	1.5	1.65	1.95
18	2.3	2.0	2.1	1.2	1.3	1.95	1.3	2.5	1.5	1.8	2.0
19	2.3	2.0	2.1	1.2	1.3	1.55	1.3	2.55	1.5	2.55	2.1
20	2.3	2.0	2.0	1.35	1.3	1.45	1.3	2.6	1.5	2.0	2.2
21	2.3	2.0	1.95	1.2	1.3	1.45	1.3	2.7	1.5	2.0	2.1
22	2.2	2.0	1.9	1.3	1.3	1.4	1.3	2.6	1.5	2.0	2.0
23	2.2	2.0	1.9	1.45	1.3	1.5	1.3	2.45	1.5	1.9	2.0
24	2.15	2.0	1.9	1.55	1.25	1.45	1.3	2.3	1.5	1.9	2.1
25	2.15	2.05	1.9	1.4	1.25	1.45	1.3	2.1	1.5	1.9	2.0
26	2.0	2.05	1.9	1.4	1.3	2.6	1.3	1.95	1.6	1.9	2.0
27	2.0	2.05	1.8	1.3	1.2	2.75	1.3	1.7	1.6	1.85	2.0
28	2.0	2.25	1.8	1.2	1.2	2.3	1.3	1.55	1.5	1.8	2.0
29	2.0	2.25	1.7	1.25	1.2	2.2	1.45	1.4	1.45	1.8	2.0
30	2.0	.....	1.6	1.3	1.2	2.1	1.3	1.4	1.4	1.8	1.85
31	2.0	.....	1.6	.....	1.2	.....	1.35	1.35	.....	1.9	.....

[a] For gage heights less than 1.3 feet during 1908 there was no flow.

NOTE.—The river was probably frozen during part, at least, of January and February.

Rating tables for Uncompahgre River near Delta, Colo.

1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	6	2.10	155	2.80	400	3.50	760
1.40	11	2.20	184	2.90	443	3.60	820
1.50	21	2.30	215	3.00	490	3.70	890
1.60	36	2.40	248	3.10	540	3.80	960
1.70	55	2.50	283	3.20	590	3.90	1,030
1.80	77	2.60	320	3.30	640	4.00	1,110
1.90	101	2.70	359	3.40	700	4.10	1,190
2.00	127						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907, and is well defined.

1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.25	0	1.50	18	1.70	52	1.90	100
1.30	1	1.60	33	1.80	74	2.00	127
1.40	7						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on thirteen discharge measurements made during 1907 and 1908 and is well defined. Above gage height 2.0 feet it is the same as the 1907 table.

Monthly discharge of Uncompahgre River near Delta, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April 21–30	55	8	19.1	379	C.
May	359	6	66.5	4,090	B.
June	960	11	368	21,900	A.
July	1,150	101	526	32,300	A.
August	400	77	196	12,100	A.
September	127	36	72.5	4,310	A.
October	170	55	81.0	4,980	A.
November	283	66	140	8,330	A.
The period				88,400	
1908.					
January	215	127	162	9,960	D.
February	200	100	132	7,590	D.
March	215	33	119	7,320	B.
April	42	0	12.2	726	C.
May	12	0	2.0	123	D.
June	380	0	75.2	4,470	A.
July	114	1	9.0	533	C.
August	515	4	150	9,220	A.
September	33	1	14.1	839	C.
October	302	4	63.2	3,890	A.
November	184	74	122	7,260	A.
The period				51,900	

SAN JUAN RIVER DRAINAGE BASIN.

DESCRIPTION.

San Juan River rises among the snow masses that crown the high peaks of the San Juan Mountains in southwestern Colorado, flows southwestward into New Mexico, then swings to the west and northwest, passing from San Juan County, N. Mex., across the extreme southwestern corner of Colorado into San Juan County, Utah, in the southwestern part of which it unites with the Colorado.

For the first 75 miles of its course the San Juan is a typical mountain stream, but at Canyon Largo, N. Mex., where it turns westward, its character changes, and it occupies a broad, winding, sandy channel in an arid valley, bordered on each side by terraced mesas. Below the mouth of Mancos River the valley narrows and the river bottom is bounded by abrupt bluffs, broken and cut by dry water channels, and merging farther on into the walls of a deep, narrow, box canyon in which the river flows to its end.

The drainage area includes portions of four States and Territories. Its topography ranges in type from mountainous at the headwaters in Colorado to the types exemplified in the valleys, plateaus, and eroded mesas of Utah, New Mexico, and Arizona. Large areas of eruptive rocks occur in the highest portions of the basin, but the predominating formations are of sedimentary origin. The headwater streams are protected by fine forests of spruce and yellow pine and at lower elevations large areas of aspen. The lower basin is practically barren except for an extensive growth of sagebrush, scattered cedars, piñons, and range grasses.

The principal tributaries of the San Juan are Navajo, Piedra, Pine, Florida, Animas, and La Plata rivers, the Animas being the most important.

Animas River has its source in the region above Silverton, draining portions of the Needle and La Plata mountains, the former being the most rugged of the Rocky Mountain ranges. The river flows southward to the Colorado-New Mexico line and thence southwestward to the point where it joins the San Juan at Farmington, N. Mex. The upper portion of the basin, above Durango, is very mountainous and furnishes the greater part of the run-off (Pl. VII, *B*, p. 128). This region is generally well timbered with pine, spruce, and aspen, but large areas consist of naked granite peaks. Immediately above and below Durango the valley broadens and is bordered by mesas and bluffs cut by narrow canyons and covered with sagebrush and scattered pines and piñons; along the stream channels cottonwoods predominate. The rocks of this region are chiefly of sedimentary origin. The soils of the lower valleys consist of sandy loam and are very fertile.

La Plata River rises in the granite masses known as La Plata Mountains, about 25 miles northwest of Durango, Colo., and flows southward to its point of junction with the San Juan. Its drainage basin is a narrow strip parallel to and adjoining the Animas basin. The upper portion of the basin is a well-watered and forest-clad mountain region which merges southward into an arid mesa, plateau, and canyon country. La Plata Valley proper is a narrow, shallow depression from Hesperus down, bounded on both sides by high, broken tablelands and deeply eroded mountains. The lower mountain slopes are covered with piñon, scrub oak, and cedar; the lower valleys support heavy growths of sagebrush and chico; the upper mountain slopes were at one time heavily timbered with spruce and yellow and white pine, but these forests have been largely removed by lumbermen.

The other tributaries of the San Juan need not here be described. Those mentioned are perennial streams, but much of their water is diverted for irrigation and never reaches the main river. In addition to the perennial streams are many intermittent creeks throughout New Mexico, which contribute large volumes of water during heavy storms.

The altitudes in this drainage basin range from over 13,000 feet in the highest mountains to between 6,000 and 7,000 feet at the Colorado-New Mexico line. The San Juan at the mouth of the Animas has an elevation of about 5,300 feet; at its junction with Colorado River the elevation is about 3,500 feet.

Most of the timbered land in the San Juan drainage basin is included in the San Juan National Forest, which contains nearly 2,000 square miles of merchantable timber, 100 square miles of woodland, 300 square miles of sagebrush, and 200 square miles of barren and burnt area.

A small area in the high mountain drainage of this stream has an annual precipitation of over 25 inches, and over a considerable area the average exceeds 20 inches; but for the remainder of the area the average in Colorado seems to be about 15 inches, that in New Mexico about 10 inches, and in Utah about 15 inches.

Above an altitude of 7,500 feet the winters are severe and snowfalls are heavy. Below an elevation of 6,000 feet the winters are comparatively open and mild. The upper mountain streams flow under a thick ice cover, but in the more open country, in the vicinity of Aztec, it is rather unusual for the rivers to freeze over entirely, though much ice forms along the edges, and slush ice is often seen.

Much land along the valleys of San Juan, Animas, Pine, Florida, and La Plata rivers and the smaller tributaries in Colorado are now under cultivation, and also a few thousand acres of valley land in New Mex-

ico. Up to this time irrigation has largely been confined to the bottom land. The greatest opportunities for future development are in San Juan County, N. Mex., where exceptionally large areas, aggregating probably a million acres of fertile lands, are excellently adapted to irrigation. The rivers there are bordered by broad mesas and benches, sloping back for miles in many places, and easily reached by irrigation canals. The water supply is ample.

Numerous small lakes, high up in the mountains, tend to equalize the flow of some of the tributaries, and many large and small storage reservoir sites are available. Among others may be mentioned the Turley reservoir site, on San Juan River below the mouth of the Pine, which has a storage capacity of about one and a half million acre-feet.

Excellent opportunities for power development are presented. Theoretically, with proper storage, it will be possible to develop nearly 300,000 horsepower. Falls of 100 to 300 feet per mile are common on the upper reaches of the stream. The San Juan has an average fall of about 13 feet to the mile from the mouth of the Piedra to the mouth of the Mancos, a distance of about 115 miles, while the fall above the mouth of the Piedra is very much greater. The Animas has a fall of over 70 feet to the mile from Silverton to Durango, a distance of about 40 miles, and from Durango to its mouth the average fall is over 20 feet to the mile. Present developments are practically limited to two power plants on Animas River, of 6,000 and 1,000 horsepower. Several other plants are contemplated.

The largest deposits of lignite, bituminous, and coking coal in the West are to be found in this drainage area.

The following gaging stations have been maintained in the San Juan basin:

San Juan River near Arboles, Colo., 1895–1899.
San Juan River at Turley, N. Mex., 1907–8.
San Juan River near Farmington, N. Mex., 1904–1906.
Piedra River near Arboles, Colo., 1895–1899.
Los Pinos River at Ignacio, Colo., 1899–1903.
Animas River at Silverton, Colo., 1903.
Animas River at Durango, Colo., 1895–1905.
Animas River at Aztec, N. Mex., 1904, 1907–8.
Animas River near Farmington, N. Mex., 1904–5.
Florida River near Durango, Colo., 1899, 1901–1903.
La Plata River at Hesperus, Colo., 1904–1906.
La Plata River near La Plata, N. Mex., 1905–1908.
Mancos River at Mancos, Colo., 1898–1900.

SAN JUAN RIVER AT TURLEY, N. MEX.[a]

This station, which was established June 6, 1907, to obtain data necessary to determine the amount of water available for irrigation from this stream, was discontinued November 30, 1908. The data

[a] A new station was established December 9, 1908, at Blanco, N. Mex., to take the place of this station.

collected are also valuable for power purposes. It was located about one-fourth of a mile north of Turley post-office and about 18 miles east of the Denver and Rio Grande Railroad at Aztec, N. Mex.

The station was about 5 miles above the mouth of Canyon Largo, which is an intermittent stream draining a vast area and discharging during flood stages thousands of second-feet of water. The drainage area of the San Juan at Turley is about 4,700 square miles.

Irrigation is carried on extensively in a number of the tributary valleys above this station, the greatest development being along Pine River and Rio Piedra. A large canal, now under construction, will divert water from Pine River to irrigate land in Colorado. The diversions below the station are mainly small private ditches. Opportunities for power and irrigation enterprises are good.

The river seldom freezes over entirely, but ice usually forms along the edges and narrows the channel considerably. Slush ice is common during the winter months.

Neither the location nor the datum of the staff gage has been changed during the maintenance of the station.

The results obtained are considered fairly good.

Discharge measurements of San Juan River at Turley, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 6	V. L. Sullivan	192	1,240	7.60	7,750
September 7	do	180	574	4.55	1,960
December 13	do	158	254	2.60	314
1908.					
April 12	V. L. Sullivan	182	790	5.40	3,080

Daily gage height, in feet, of San Juan River at Turley, N. Mex., for 1907 and 1908.

[Jay Turley and A. C. Jaquez, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1							8.65	5.00	.....	3.30	3.25	2.55
2							8.60	5.20	5.00	3.40	3.20	2.60
3							8.30	5.50	4.80	3.30	3.15	2.55
4							8.20	5.30	4.60	3.30	3.05	2.55
5							8.15	5.10	4.50	3.35	3.05	2.60
6						7.57	8.05	4.80	4.65	3.30	3.00	2.65
7						7.65	7.90	4.72	4.55	3.25	3.00	2.75
8						7.70	7.60	4.58	4.45	3.70	3.00	2.80
9						7.50	7.50	4.45	4.35	3.50	3.00	2.75
10						7.20	7.20	4.33	4.30	3.40	2.95	2.70
11						7.05	7.05	4.24	4.20	3.30	2.95	2.75
12						7.35	6.90	4.10	3.90	3.25	2.90	2.70
13						7.85	7.00	5.25	3.80	3.20	2.90	2.65
14						7.90	7.30	5.00	3.75	3.15	2.90	2.55
15						8.00	7.20	4.72	3.70	3.10	2.85	2.60
16						7.90	6.90	4.35	3.65	3.15	2.80	2.65
17						7.85	6.45	4.20	3.60	3.10	2.90	2.65
18						8.00	6.30	4.08	3.90	3.05	2.95	2.70
19						7.85	6.20	4.30	4.25	3.05	2.90	2.75
20						7.65	6.20	4.41	4.20	3.05	2.85	2.50

Daily gage height, in feet, of San Juan River at Turley, N. Mex., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
21						7.40	6.15	4.60	4.10	3.00	2.80	2.55
22						7.40	6.00	4.60	4.00	3.00	2.75	2.75
23						7.20	5.93	4.32	3.85	3.00	2.65	2.85
24						7.50	5.75	4.65	3.75	3.20	2.55	2.60
25						7.70	6.80	4.45	3.70	3.30	2.70	2.70
26						7.95	5.92	4.50	3.60	3.30	2.65	3.00
27						8.05	5.78	4.44	3.55	3.20	2.70	2.90
28						8.25	5.55	4.70	3.45	3.10	2.75	2.75
29						8.40	5.40	.....	3.40	3.10	2.85	2.60
30						8.55	5.28	.....	3.35	3.25	2.75	2.50
31						.....	5.10	.....	.....	3.35	.....	2.60
1908.												
1	2.7	2.65	3.8	4.4	5.8	5.55	5.45	4.8	3.6	3.0	3.0	.....
2	2.85	2.75	3.3	4.45	6.0	6.0	5.2	8.8	3.7	3.05	2.9	.....
3	2.6	3.85	3.3	4.7	5.9	5.85	5.1	5.6	3.5	3.1	2.75	.....
4	2.65	5.1	3.3	4.8	5.65	6.1	5.0	5.28	3.6	3.1	2.85	.....
5	2.8	4.05	4.3	5.2	5.35	6.2	4.9	5.0	3.5	3.0	2.8	.....
6	2.7	3.25	4.6	5.25	5.1	6.2	5.0	4.8	3.4	2.9	2.9	.....
7	2.7	2.7	4.0	5.2	5.0	5.8	4.8	5.8	3.3	2.95	2.85	.....
8	2.8	2.65	3.7	5.3	5.0	5.7	4.85	4.8	3.1	3.0	2.95	.....
9	2.65	2.6	4.2	5.3	5.3	5.8	4.7	4.7	3.0	3.05	2.9	.....
10	2.75	2.7	3.5	5.35	5.3	6.4	4.65	4.3	3.0	3.05	3.0	.....
11	2.85	2.6	3.65	5.4	5.1	6.6	4.5	4.2	2.9	3.0	3.05	.....
12	2.9	2.55	3.95	5.4	5.0	5.8	4.5	4.0	2.9	3.05	2.95	.....
13	2.8	2.5	4.3	5.2	5.0	6.7	4.55	4.4	2.9	3.0	2.85	.....
14	2.7	2.45	4.5	5.4	4.9	6.6	4.6	4.8	2.9	3.0	2.7	.....
15	2.6	2.75	4.85	5.6	4.7	6.4	4.6	5.0	2.9	3.1	2.75	.....
16	2.65	2.95	4.95	6.2	4.7	6.8	4.7	5.4	2.8	.....	2.65	.....
17	2.65	3.85	5.25	6.1	5.3	6.0	4.6	5.4	2.95	3.0	2.6	.....
18	2.8	3.2	5.75	5.8	5.2	5.4	4.5	5.2	2.9	3.05	2.55	.....
19	2.95	3.15	5.6	5.65	6.15	5.3	4.4	5.4	3.0	3.1	2.4	.....
20	2.7	3.05	5.2	5.8	6.1	5.2	4.3	5.6	3.1	3.15	2.3	.....
21	2.75	2.8	5.0	5.9	5.9	5.6	4.32	6.05	3.0	3.2	2.25	.....
22	2.75	2.95	5.0	5.45	5.7	5.4	4.35	5.0	3.05	3.2	2.2	.....
23	2.7	3.8	4.7	5.55	5.55	5.7	4.2	4.9	3.0	3.1	2.25	.....
24	2.65	3.6	4.7	5.55	5.4	5.6	4.15	4.8	3.0	3.15	2.15	.....
25	2.75	3.5	4.8	5.3	5.25	5.4	4.25	4.5	2.95	3.15	2.1	.....
26	2.8	3.8	4.95	5.15	5.0	6.3	4.25	4.5	2.95	3.15	2.15	.....
27	2.7	3.85	5.05	5.0	5.0	6.6	4.25	4.4	3.0	3.1	2.25	.....
28	2.7	3.8	4.85	4.85	4.9	6.5	4.15	4.2	3.0	3.0	2.15	.....
29	2.75	3.8	4.65	4.8	4.8	5.7	4.38	4.0	3.0	3.05	2.1	.....
30	2.6	.....	4.5	4.75	4.75	5.5	4.4	4.0	3.05	3.0	2.05	.....
31	2.6	.....	4.3	.....	4.85	.....	4.6	3.95	.....	3.05	.....	.....

Rating table for San Juan River at Turley, N. Mex., for June 6, 1907, to November 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	100	3.30	760	4.60	1,990	6.60	5,250
2.10	130	3.40	840	4.70	2,110	6.80	5,680
2.20	160	3.50	920	4.80	2,230	7.00	6,150
2.30	195	3.60	1,000	4.90	2,350	7.20	6,650
2.40	235	3.70	1,090	5.00	2,480	7.40	7,170
2.50	280	3.80	1,180	5.20	2,750	7.60	7,720
2.60	330	3.90	1,270	5.40	3,050	7.80	8,310
2.70	380	4.00	1,360	5.60	3,350	8.00	8,910
2.80	430	4.10	1,460	5.80	3,680	8.20	9,510
2.90	490	4.20	1,560	6.00	4,040	8.40	10,120
3.00	550	4.30	1,660	6.20	4,420	8.60	10,740
3.10	620	4.40	1,770	6.40	4,830	8.80	11,360
3.20	690	4.50	1,880				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907 and 1908. These measurements lying between gage heights 2.5 feet and 8.0 feet are well distributed and form a good curve. They are insufficient in number, however, to indicate any possible change in conditions of flow.

Monthly discharge of San Juan River at Turley, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet)	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
June 6-30	10,600	6,280	8,150	404,000	A.
July	10,900	2,610	6,030	371,000	A.
August	3,200	1,440	2,080	128,000	A.
September	2,480	800	1,450	86,300	A.
October	1,090	550	711	43,700	A.
November	725	305	489	29,100	B.
December	550	280	367	22,600	B.
The period				1,080,000	
1908.					
January	520	330	395	24,300	B.
February	2,610	258	766	44,100	A.
March	3,600	760	1,920	118,000	A.
April	4,420	1,770	2,930	174,000	A.
May	4,320	2,110	2,910	179,000	A.
June	5,680	2,750	4,020	239,000	A.
July	3,120	1,510	1,990	122,000	A.
August	11,400	1,320	2,550	157,000	A.
September	1,090	430	627	37,300	A.
October	690	490	592	36,400	A.
November	585	115	337	20,100	B.
The period				1,150,000	

NOTE.—The above accuracy notes are based on the assumption of constant conditions of flow. See rating-table foot note.

Discharge estimated for days in August and September, 1907, that the gage record is missing.

SAN JUAN RIVER AT BLANCO, N. MEX.

This station was established December 9, 1908, and takes the place of the station at Turley, which was discontinued November 30, 1908. It is located at the new suspension bridge, which crosses the San Juan at Blanco about 4 miles below Turley post-office, 16 miles southeast of the Denver and Rio Grande Railroad, at Aztec, N. Mex., and one-half mile above the mouth of Canyon Largo.

The following discharge measurement was made by J. B. Stewart:

December 10, 1908:[a] Width, 194 feet; area, 194 square feet; gage height, 2.60 feet;[b] discharge, 157 second-feet.

Daily gage height, in feet, of San Juan River at Blanco, N. Mex., for 1908.

Day.	Dec.	Day.	Dec.	Day.	Dec.
1		11	2.6	21	2.75
2		12	2.4	22	2.8
3		13	2.4	23	3.0
4		14	2.4	24	3.0
5		15	2.7	25	2.85
6		16	3.0	26	2.8
7		17	2.4	27	2.7
8		18	3.0	28	2.7
9	2.6	19	2.8	29	2.6
10	2.6	20	2.8	30	2.7
				31	2.7

[a] Slush ice. [b] Chain gage.

ANIMAS RIVER AT AZTEC, N. MEX.

This station was originally established June 21, 1904, at a wooden-truss highway bridge about three-eighths of a mile west of Aztec, N. Mex. It was discontinued December 14, 1904, and reestablished at the same location on June 8, 1907. On September 13, 1908, it was moved to a new suspension bridge about half a mile above the old bridge, which was torn down on completion of the new bridge. The station is about one-third of a mile west of Aztec, on the main wagon road to Farmington and La Plata.

No change in the staff gage or gage datum occurred during the maintenance of the station at the old location. Beginning September 13, 1908, an inclined staff gage, installed a few feet downstream from the suspension bridge at an arbitrary datum, was read.

The records obtained at this point are valuable for irrigation and power projects, as the irrigable area in this basin is large and the fall of the river is heavy.

The station, although 20 miles above the mouth of the river, is below all important tributaries. The drainage area is about 1,300 square miles. Between Durango and Aztec many large ditches divert water for irrigation, and the discharge at this station does not represent the total run-off of the stream. Notwithstanding numerous existing water rights, an ample supply of water is available for future development.

Ice forms to a considerable depth along the edges during the greater part of the winter, but the river seldom freezes across. Slush ice occurs frequently during the winter months.

Results are good except during July, August, and September, 1908, when the shifting of the channel interfered with the accuracy of the data.

Discharge measurements of Animas River at Aztec, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec. ft.*
June 8	V. L. Sullivan	150	762	8.50	3,660
September 9	do	90	336	6.90	826
December 15	do	96	189	6.00	269
1908.					
April 13	Jay Turley	116	421	7.30	1,141
September 12	V. L. Sullivan	126	141	[a] 3.60	358
December 9 [b]	J. B. Stewart	82	108	[a] 3.30	181

[a] New gage at different datum. [b] Wading measurement.

Daily gage height, in feet, of Animas River at Aztec, N. Mex., for 1907 and 1908.

[J. M. Thomas, H. S. Wattles, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1							9.0	7.6	7.8	6.5	6.3	6.0
2							9.0	7.7	7.5	6.5	6.3	6.0
3							8.9	8.1	7.3	6.4	6.3	6.0
4							8.8	8.0	7.1	6.4	6.3	6.0
5							8.8	7.8	7.1	6.4	6.3	6.0
6							9.0	7.8	7.1	6.4	6.3	6.0
7							8.95	7.5	7.1	6.5	6.2	6.0
8						8.50	8.9	7.4	7.0	6.5	6.2	6.0
9							8.7	7.3	6.9	6.5	6.2	6.0
10							8.6	7.2	6.9	6.5	6.2	6.0
11							8.5	7.2	6.8	6.5	6.2	6.0
12							8.5	7.1	6.8	6.5	6.2	6.0
13							8.45	7.2	6.7	6.5	6.2	6.0
14						8.7	8.6	7.2	6.7	6.5	6.2	6.0
15						8.65	8.9	7.2	6.8	6.5	6.1	6.0
16						8.65	8.6	7.1	7.1	6.5	6.1	6.0
17						8.7	8.4	7.0	7.0	6.4	6.1	6.0
18						8.9	8.2	7.0	7.1	6.4	6.1	6.0
19						9.0	8.15	6.95	7.2	6.4	6.1	6.0
20						8.8	8.1	6.9	7.3	6.4	6.1	6.0
21						8.5	8.15	7.8	7.4	6.4	6.1	6.0
22						8.5	8.1	7.3	7.3	6.4	6.1	6.0
23						8.3	8.1	7.2	6.9	6.4	6.1	6.0
24						8.4	8.0	7.0	6.8	6.4	6.1	6.0
25						8.65	8.0	6.9	6.8	6.4	6.1	6.0
26						8.75	8.0	6.9	6.7	6.4	6.1	6.0
27						8.75	8.0	7.1	6.7	6.4	6.1	6.0
28						8.8	7.9	7.5	6.6	6.4	6.1	6.0
29						8.8	7.9	7.1	6.6	6.4	6.1	6.0
30						9.0	7.8	7.9	6.6	6.4	6.0	6.0
31							7.7	7.7		6.3		6.0
1908.												
1	6.0	6.2	6.3	7.2	7.1	8.0	8.5	7.3	6.3	3.5	3.5	3.4
2	6.0	6.2	6.3	7.2	7.5	8.1	8.2	6.8	6.2	3.5	3.5	3.4
3	6.0	6.3	6.3	7.1	7.6	8.0	7.9	6.7	6.1	3.5	3.5	3.45
4	6.0	6.3	6.3	7.1	7.6	7.9	7.6	6.9	6.0	3.5	3.5	3.45
5	6.0	6.4	6.5	7.2	7.5	8.0	7.4	7.0	6.0	3.6	3.5	3.5
6	6.0	6.4	6.5	7.2	7.7	8.1	7.4	6.8	5.9	3.5	3.5	3.45
7	6.0	6.3	6.4	7.3	7.6	8.2	7.4	7.0	5.9	3.5	3.5	3.4
8	6.0	6.2	6.4	7.3	7.5	8.4	7.3	6.8	5.8	3.5	3.5	3.35
9	6.0	6.2	6.5	7.2	7.6	8.4	7.2	6.9	5.7	3.45	3.5	3.3
10	6.0	6.2	6.5	7.3	7.6	8.5	7.3	6.7	5.6	3.4	3.5	3.4
11	6.0	6.2	6.3	7.2	7.5	8.3	7.3	6.6	5.6	3.4	3.5	3.4
12	6.0	6.0	6.4	7.2	7.6	8.6	7.3	6.6	5.6	3.4	3.4	3.4
13	6.0	6.0	6.7	7.3	7.6	8.4	7.2	6.7	3.6	3.4	3.4	3.4
14	6.0	6.0	7.0	7.3	7.7	8.6	7.2	6.7	3.6	3.4	3.4	3.4
15	6.0	6.0	7.0	7.3	7.8	8.5	7.2	6.9	3.6	3.4	3.4	3.6
16	6.0	6.0	7.2	7.4	7.7	8.6	7.1	7.0	3.5	3.4	3.4	4.0
17	6.0	6.0	7.5	7.5	7.8	8.7	7.3	7.1	3.5	3.4	3.4	4.2
18	6.3	6.0	7.4	7.5	8.0	8.5	7.2	7.3	3.5	3.4	3.4	3.9
19	6.5	6.0	7.6	7.5	8.1	8.4	7.3	7.4	3.5	3.6	3.4	3.5
20	6.4	6.0	7.8	7.6	8.3	8.2	6.8	7.5	3.5	3.7	3.4	3.4
21	6.3	6.0	7.7	7.8	8.5	8.3	6.9	7.4	3.5	3.7	3.4	3.4
22	6.3	6.0	7.7	7.7	8.3	8.4	6.7	7.3	3.5	3.7	3.4	3.4
23	6.3	6.1	7.8	7.6	8.0	8.4	6.6	7.2	3.5	3.6	3.4	3.4
24	6.3	6.2	7.5	7.5	7.9	8.5	6.5	7.1	3.5	3.6	3.4	3.4
25	6.3	6.3	7.6	7.5	7.9	8.4	6.4	6.9	3.5	3.6	3.4	3.4
26	6.3	6.3	7.7	7.4	7.8	8.4	6.4	6.8	3.5	3.6	3.4	3.4
27	6.3	6.3	7.6	7.4	7.7	8.5	6.5	6.7	3.7	3.6	3.4	3.4
28	6.3	6.2	7.5	7.3	7.6	8.4	6.7	6.7	3.7	3.5	3.4	3.4
29	6.2	6.2	7.4	7.2	7.5	8.4	6.6	6.6	3.7	3.5	3.4	3.4
30	6.2		7.3	7.2	7.7	8.5	6.8	6.5	3.6	3.5	3.4	3.4
31	6.2		7.3		8.0		6.6	6.4		3.5		3.4

NOTE.—New gage at different datum, September 13 to December 31, 1908.

Rating tables for Animas River at Aztec, N. Mex.

JUNE 14, 1907, TO JULY 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.00	270	6.80	720	7.60	1,570	8.40	3,340
6.10	310	6.90	800	7.70	1,720	8.50	3,660
6.20	350	7.00	880	7.80	1,890	8.60	4,000
6.30	400	7.10	970	7.90	2,080	8.70	4,360
6.40	450	7.20	1,070	8.00	2,290	8.80	4,730
6.50	510	7.30	1,180	8.10	2,520	8.90	5,110
6.60	570	7.40	1,300	8.20	2,770	9.00	5,500
6.70	640	7.50	1,430	8.30	3,040		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907 and 1908, and is fairly well defined.

JULY 5 TO SEPTEMBER 12, 1908.

[The indirect method for shifting channels used.]

SEPTEMBER 13 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	180	3.60	350	3.90	532	4.10	657
3.40	235	3.70	410	4.00	594	4.20	721
3.50	292	3.80	471				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908 and 1909, and is fairly well defined.

Daily discharge, in second-feet, of Animas River at Aztec, N. Mex., July 5 to September 12, 1908.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	.....	1,200	620	11	1,230	790	360	21	970	1,250	.....
2	.....	900	575	12	1,230	790	350	22	860	1,180	.....
3	.....	850	535	13	1,160	840	.....	23	810	1,120	.....
4	.....	955	495	14	1,160	840	.....	24	758	1,040	.....
5	.....	1,010	480	15	1,160	945	.....	25	705	937	.....
6	1,300	900	450	16	1,100	1,000	.....	26	705	880	.....
7	1,300	1,010	440	17	1,230	1,060	.....	27	753	822	.....
8	1,230	893	400	18	1,160	1,180	.....	28	852	822	.....
9	1,160	947	380	19	1,220	1,250	.....	29	800	772	.....
10	1,230	840	370	20	915	1,320	.....	30	908	720	.....
								31	800	670	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Animas River at Aztec, N. Mex., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
June 14–30	5,500	3,040	4,370	147,000	A.
July	5,590	1,720	3,540	218,000	A.
August	2,520	800	1,300	79,900	A.
September	1,890	570	903	53,700	A.
October	510	400	472	29,000	A.
November	400	270	337	20,100	A.
December	270	270	270	16,600	B.
The period				564,000	

Monthly discharge of Animas River at Aztec, N. Mex., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	510	270	329	20,200	A.
February	450	270	336	19,300	A.
March	1,890	400	1,020	62,700	A.
April	1,890	970	1,250	74,400	A.
May	3,660	970	1,880	116,000	A.
June	4,360	2,080	3,240	193,000	A.
July	3,660	705	1,230	75,600	D.
August	1,320	670	959	59,000	D.
September	620	292	377	22,400	C.
October	410	235	299	18,400	A.
November	292	233	256	15,200	A.
December	721	180	279	17,200	A.
The year	4,360	180	955	693,000	

NOTE.—Discharge for period July 5 to September 12, 1908, obtained by indirect method for shifting channel.

LA PLATA RIVER AT LA PLATA, N. MEX.

This station, which was established May 25, 1905, to obtain data for use by the United States Reclamation Service in connection with their proposed La Plata project, is located at a wooden, single span highway bridge, about 16 miles northwest of Aztec, N. Mex., and 1 mile south of La Plata post-office, in sec. 3, T. 31 N., R. 13 W. of New Mexico principal meridian. Being located below all the principal diversions, the station shows the amount of flood water available for storage and irrigation.

The station is below all tributaries and about 15 miles above the mouth of the La Plata. The drainage area is about 340 square miles.

Nearly all the normal flow of this stream is diverted for irrigation above the station, and there are a few small diversions below.

Ice conditions are not very severe, although thin ice frequently forms across the stream during the winter period. Thick ice often forms along the edges, and slush ice at times interferes with winter measurements.

On December 9, 1908, a chain gage was installed on the bridge and is read in place of the rod gage, as the latter does not record low stages. The datum remained unchanged.

Because of shifting conditions of channel and the uncertainty of some of the gage heights the results are not good.

Discharge measurements of La Plata River near La Plata, N. Mex., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 8	V. L. Sullivan	32	69	3.55	203
September 8	do	30	20	2.00	27
December 14	do	5	0.9	.60	0.7
1908.					
April 11	V. L. Sullivan	32	27	2.33	73
July 25	do			.60	[a] 0
December 8	J. B. Stewart			1.33	[b] 1.0
December 9	do			1.40	[b] 1.5

[a] River dry. [b] Discharge estimated.

Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1907 and 1908.

[John Smith, Frank Williams, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1							3.0	1.0	2.6	1.0	0.7	0.6
2							3.0	2.0	2.4	.8	.7	.7
3							3.0	3.0	2.2	.8	.7	.7
4							2.8	1.0	2.2	.8	.7	.7
5							2.8	1.0	2.2	.7	.7	.7
6							2.6	1.0	2.2	.7	.7	.7
7						3.5	2.4	1.0	2.2	.7	.6	.7
8						3.5	2.4	1.0	2.2	.7	.6	.7
9						3.4	2.2	1.0	2.2	.7	.6	.7
10						3.4	2.0	1.0	2.0	.7	.6	.6
11						3.4	2.0	1.0	2.0	.7	.6	.6
12						3.3	1.6	1.0	2.0	.7	.6	.6
13						3.2	1.6	1.0	2.0	.7	.6	.6
14						3.2	1.5	1.0	2.0	.7	.6	.6
15						3.1	1.5	1.0	2.0	.7	.6	.5
16						3.1	1.3	1.0	2.0	.6	.6	.6
17						3.1	1.3	1.2	1.8	.6	.7	.5
18						2.8	1.3	1.2	1.8	.6	.7	.5
19						3.4	1.2	1.2	2.9	.6	.7	.5
20						3.6	1.2	1.2	2.2	.6	.6	.5
21						3.2	1.2	5.0	2.0	.6	.6	.5
22						3.2	1.0	3.0	1.8	.7	.6	.4
23						3.1	1.0	2.6	1.8	.7	.6	.4
24						3.1	1.0	2.2	1.6	.7	.6	.4
25						3.2	1.0	3.0	1.6	.7	.6	.4
26						3.2	4.5	2.6	1.6	.7	.6	.4
27						3.3	3.0	2.2	1.4	.7	.6	.5
28						3.2	2.4	2.2	1.2	.7	.6	.5
29						3.1	1.0	5.15	1.0	.7	.6	.5
30						3.1	1.0	3.3	1.0	.7	.6	.4
31							1.0	2.8		.7		.5
1908.												
1	0.5	0.7	1.3	1.8	1.5	1.4	0.7	6.6				
2	.5	.7	1.4	1.6	1.6	1.2	.6	.7				
3	.5	1.0	1.2	1.5	1.6	1.0	.6	.6				
4	.5	3.5	1.2	1.6	1.6	1.0	.6	.7				
5	.5	1.9	1.2	1.8	1.5	1.0	.6	.6				
6	.6	1.6	1.4	2.0	1.5	1.0	.6	3.2				
7	.6	1.4	1.4	1.9	1.5	1.0	.6	.6				
8	.5	1.4	1.2	2.0	1.5	1.0	.6	.6				1.33
9	.5	1.4	1.2	1.9	1.6	1.0	.6	.5				1.4
10	.5	1.6	1.0	1.9	1.6	1.2	.6	.5				1.4
11	.5	1.6	1.0	1.8	1.5	1.4	.6	.6				1.3
12	.5	1.4	1.8	1.9	1.4	1.2	.6	.6				1.3
13	.6	1.2	1.3	1.8	1.4	1.2	.5	.6				1.3
14	.6	1.2	1.4	1.9	1.3	1.2	.6	.6				1.4
15	.6	1.0	1.6	2.0	1.2	1.2	.6	.5				1.5
16	.6	1.2	1.8	2.2	1.2	1.0	.7	3.2				1.6
17	.6	1.2	1.8	2.4	1.2	1.0	.7	.8				1.5
18	.6	1.2	2.0	2.2	1.4	.8	.7	2.2				1.3
19	.6	1.2	2.0	2.2	1.6	.7	.6	2.0				1.4
20	.6	1.4	2.2	2.4	1.8	.7	.6	5.6				1.4
21	.6	1.4	2.4	2.0	1.6	.7	.6	2.4				1.4
22	.7	2.0	2.4	1.8	1.6	.7	2.6	1.8				1.3
23	.7	3.0	2.4	1.9	1.8	.7	.6	2.0				1.4
24	.7	2.5	2.2	1.6	1.5	.7	.6	2.0				1.4
25	.7	1.6	2.0	1.6	1.3	.7	.6	1.8				1.4
26	.7	1.8	1.8	1.5	1.2	.7	.6	1.6				1.4
27	.7	1.8	1.8	1.5	1.2	.7	.5	1.4				1.4
28	.7	1.4	2.0	1.4	1.2	.7	.5	1.0				1.4
29	.7	1.4	1.8	1.4	1.0	.7	3.0					1.4
30	.7		1.9	1.3	.9	.7	.5					1.3
31	.7		2.0		1.2		2.0					1.3

NOTE.—Gage out of water August 29 to December 8, 1908. During this period the average flow was about 1 second-foot per day. New gage established December 9, 1908.

LITTLE COLORADO RIVER DRAINAGE BASIN.

DESCRIPTION.

The country drained by Little Colorado River consists of a high plateau with an elevation over 4,000 feet above sea level, extending from the Continental Divide in northwestern New Mexico westward to the San Francisco Mountains in Arizona and from the Grand Canyon of the Colorado southward to the Mogollon Mesa. The greater part of this plateau is composed of rolling plains with a few feet of soil at the surface underlain by rock. Through this plateau the river winds northwestward to its junction with the great Colorado.

The run-off from approximately 6,000 square miles of the drainage area finds its way into the Little Colorado above the mouth of Rio Puerco, the largest tributary, which joins the main stream 2 miles above the town of Holbrook, Ariz. Both the Little Colorado and Rio Puerco are flashy streams, seldom clear even during low stages. They have shifting sandy bottoms, and where not confined in canyons the stream beds are wide with abrupt earth banks. The discharge fluctuates greatly, being insignificant in dry seasons. The floods are short and violent and carry large quantities of silt in suspension.

The following stations have been maintained in this river basin:

Little Colorado at St. Johns, Ariz., 1906–1908.
Little Colorado at Woodruff, Ariz., 1905–1908.
Little Colorado at Holbrook, Ariz., 1905–1908.
Silver Creek near Snowflake, Ariz., 1906–1908.
Silver Creek at Canyon Station, Ariz., 1906.
Woodruff ditch at Woodruff, Ariz., 1906.
Chevelon Fork near Winslow, Ariz., 1906–1908.
Clear Creek near Winslow, Ariz., 1906–1908.

LITTLE COLORADO RIVER AT ST. JOHNS, ARIZ.

This station, which was established April 18, 1906, to determine the amount of water available for irrigation, is located at the south end of the town of St. Johns, one-half mile above the dam and county bridge. The bed of the stream is clean, sandy, and shifting. Frequent measurements are necessary to properly determine the daily flow at this station. The results given in the following tables were furnished by the United States Reclamation Service:

Discharge measurements of Little Colorado River at St. Johns, Ariz., in 1907 and 1908.

[By W. D. Rencher.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
January 5	4.65	67	February 27	4.94	92	April 26	4.60	69
January 10	4.75	80	March 6	4.91	75	April 30	4.56	69
January 16	4.66	54	March 13	5.00	87	May 6	4.30	51
January 22	4.53	36	March 19	5.11	127	May 30	4.27	49
January 29	4.66	40	March 23	6.40	430			
February 2	4.87	70	March 29	5.66	260	1908.		
February 8	4.92	89	April 1	5.60	259	July 21[a]	1.10	54
February 15	4.86	69	April 13	5.50	220			
February 21	4.84	68	April 19	5.10	150			

[a] River bed lately eroded 4 feet deeper.

Daily gage height, in feet, of Little Colorado River at St. Johns, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.61	4.73	4.94	6.20	4.58	4.14	3.87	4.18	4.85	3.23	3.70	3.94
2	4.50	4.81	4.94	6.27	4.55	4.07	3.90	4.24	4.57	3.23	3.70	3.94
3	4.60	4.77	4.93	5.77	4.45	4.04	3.90	4.54	4.80	3.22	3.83	3.94
4	4.72	4.77	4.94	5.82	4.36	4.04	3.90	4.25	5.40	3.22	3.81	3.95
5	4.65	4.76	4.94	5.78	4.32	3.99	3.89	4.27	4.45	3.22	3.80	3.95
6	4.67	4.83	4.92	5.45	4.29	3.97	3.89	4.20	5.50	3.21	3.80	3.95
7	4.68	4.88	4.95	5.65	4.26	3.94	3.86	4.17	5.40	3.20	3.80	3.95
8	4.68	4.92	5.02	5.75	4.22	3.92	3.83	4.23	5.00	3.19	3.80	3.94
9	4.68	4.86	5.04	5.73	4.19	3.90	3.81	4.34	4.52	3.18	3.80	3.93
10	4.73	4.88	5.02	5.75	4.16	3.90	3.80	4.25	4.11	3.18	3.80	3.93
11	4.71	4.85	4.96	5.72	4.14	3.90	3.79	4.20	3.97	3.18	3.80	3.92
12	4.73	4.82	4.99	6.70	4.11	3.90	3.78	4.38	3.99	3.16	3.88	3.92
13	4.70	4.82	4.98	5.60	4.10	3.89	3.77	4.35	3.79	3.16	3.91	3.91
14	4.69	4.82	4.90	5.70	4.09	3.88	3.78	4.20	3.68	3.16	3.83	3.90
15	4.70	4.85	4.93	5.46	4.11	3.87	3.77	4.17	3.68	3.16	3.80	3.91
16	4.68	4.88	4.93	5.35	4.11	3.86	3.77	4.08	3.55	3.18	3.80	3.90
17	4.68	4.87	4.96	5.27	4.09	3.85	3.78	4.45	3.73	3.20	3.80	3.90
18	4.67	4.90	4.97	5.18	4.08	3.84	3.77	4.42	3.70	3.22	3.84	3.91
19	4.64	4.91	5.05	5.12	4.04	3.84	3.77	4.22	3.53	3.22	3.96	3.92
20	4.64	4.86	5.30	5.10	4.03	3.84	3.77	4.45	3.46	3.22	3.94	3.94
21	4.66	4.84	5.65	5.08	4.02	4.43	3.79	6.10	3.41	3.22	3.93	3.95
22	4.62	4.85	6.05	5.07	4.01	4.42	3.83	5.65	3.39	3.22	3.91	3.94
23	4.53	4.85	6.37	5.03	3.99	4.36	4.25	5.14	3.36	3.30	3.90	3.88
24	4.55	4.94	6.20	4.95	3.97	4.26	4.05	4.84	3.34	4.12	3.90	3.85
25	4.57	4.97	6.13	4.83	3.94	4.22	4.62	5.72	3.31	4.08	3.90	3.85
26	4.61	4.95	6.07	4.68	3.93	4.21	5.00	5.98	3.29	4.00	3.90	3.85
27	4.64	4.95	5.97	4.58	3.93	4.14	4.62	6.58	3.27	3.94	3.92	3.85
28	4.60	4.94	5.85	4.52	4.02	3.98	4.43	5.35	3.25	3.88	4.00	3.85
29	4.60	.....	5.68	4.56	4.05	3.95	4.28	4.80	3.24	3.79	3.99	3.94
30	4.60	.....	5.63	4.56	4.25	3.91	4.16	5.55	3.24	3.76	3.94	4.00
31	4.62	.....	5.59	.....	4.27	.....	4.07	5.30	.....	3.75	.....	4.00
1908.												
1	3.94	4.10	4.41	4.50	3.51	3.31	3.22	0.97	1.13	0.75	0.77	0.85
2	3.92	4.10	4.40	4.53	3.45	3.30	3.22	2.15	.85	.75	.77	.85
3	4.00	4.10	4.38	4.50	3.45	3.29	3.22	1.52	.88	.75	.78	.90
4	4.03	4.24	4.44	4.50	3.42	3.28	3.21	2.45	.83	.75	.78	.90
5	4.00	4.38	4.50	4.53	3.40	3.28	3.20	1.60	.95	.75	.79	.92
6	4.02	4.32	5.15	4.80	3.40	3.28	3.20	.94	.90	.73	.80	.92
7	4.00	4.27	5.08	4.90	3.49	3.23	3.20	.89	.94	.72	.80	.90
8	4.02	4.22	4.78	4.80	3.55	3.17	3.20	.82	.95	.71	.80	.92
9	4.05	4.14	4.47	4.74	3.70	3.15	3.20	1.88	.99	.71	.80	.92
10	4.00	4.10	4.37	4.70	3.62	3.15	3.20	5.10	1.00	.70	.80	.90
11	3.97	4.05	4.31	4.64	3.51	3.15	3.20	1.60	1.00	.70	.80	.89
12	3.95	4.05	4.25	4.57	3.49	3.14	3.30	.92	1.10	.70	.80	.85
13	3.95	4.04	4.25	4.53	3.43	3.14	3.22	1.10	1.05	.70	.80	.85
14	3.95	4.02	4.20	4.52	3.39	3.16	3.40	1.28	.88	.70	.80	.85
15	3.96	4.01	4.31	4.50	3.34	3.19	3.35	1.00	.80	.70	.82	.89
16	4.00	4.02	4.75	4.44	3.32	3.18	4.98	1.05	.80	.70	.82	.86
17	4.03	4.05	5.15	4.38	3.32	3.18	8.75	.90	.87	.70	.81	.90
18	4.03	4.07	5.50	4.30	3.32	3.18	4.00	3.69	.80	.71	.82	.87
19	4.02	4.03	5.75	4.20	3.35	3.17	2.25	2.13	.80	.74	.82	.86
20	4.01	4.06	5.85	4.17	3.35	3.16	1.30	1.85	.80	.76	.83	.85
21	4.02	4.11	5.25	4.05	3.34	3.16	1.13	1.90	.80	.76	.85	.85
22	4.05	4.14	5.13	3.93	3.33	3.19	1.02	1.95	.80	.75	.85	.85
23	4.06	4.35	5.05	3.84	3.48	3.22	.93	1.40	.80	.75	.85	.85
24	4.02	4.88	5.01	3.86	3.41	3.21	2.25	.92	.81	.75	.87	.85
25	4.00	4.46	5.10	3.85	3.40	3.20	.94	1.18	.80	.75	.90	.85
26	4.00	4.37	5.14	3.78	3.39	3.22	.90	.90	.80	.75	.89	.85
27	4.00	4.35	5.20	3.72	3.38	3.22	1.29	.89	.77	.75	.91	.85
28	4.04	4.33	4.82	3.62	3.38	3.22	2.15	1.25	.75	.75	.88	.85
29	4.05	4.40	4.78	3.57	3.35	3.22	2.10	1.02	.75	.75	.86	.87
30	4.08	.....	4.73	3.56	3.32	3.22	1.02	1.00	.75	.75	.85	.86
31	4.10	.....	4.60	.....	3.32	.....	1.00	1.14	.....	.77	.....	.85

Daily discharge, in second-feet, of Little Colorado River at St. Johns, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	64	53	88	386	70	16	60	75	76	193	37
2	54	70	86	403	68	17	60	76	80	178	35
3	63	67	80	286	60	18	58	80	82	161	34
4	78	67	85	296	54	19	50	80	127	149	33
5	67	66	85	288	51	20	50	75	183	144	32
6	70	73	75	215	49	21	57	68	259	141	32
7	73	83	80	259	47	22	50	68	350	138	30
8	74	89	95	281	43	23	36	68	428	130	29
9	74	75	100	278	41	24	37	90	386	118	29
10	80	75	95	281	39	25	39	95	368	100	27
11	82	72	85	275	37	26	42	92	356	81	27
12	74	68	92	506	37	27	45	92	331	70	27
13	68	68	86	248	36	28	41	90	302	65	32
14	64	68	75	270	35	29	41	.....	265	69	33
15	64	69	76	218	37	30	41	.....	254	69	46
						31	43	.....	245	.....	48

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Colorado River at St. Johns, Ariz, for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	82	36	58.0	3,570
February	95	53	75.4	4,190
March	428	75	173	10,600
April	[a] 554	65	210	12,500
May	70	27	39.8	2,450

[a] Maximum recorded discharge for the month, April 2, 1907.

LITTLE COLORADO RIVER AT WOODRUFF, ARIZ.

This station, which was established March 16, 1905, and was discontinued December 31, 1908, was located about 100 yards below the crossing of the Holbrook-Winslow wagon road and one-fourth mile below the Woodruff dam.

The station equipment, which was carried away by the flood of November 26 and 27, 1905, was replaced March 24, 1906. The object of the station was to determine the amount of water available for irrigation. The bed of the stream is sandy and shifting, and frequent measurements are required to determine the daily flow.

The results published in the following tables were furnished by the United States Reclamation Service.

Discharge measurements of Little Colorado River at Woodruff, Ariz., in 1907.

[By Newman, Wakefield, and Conner.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 1	0.50	50	February 4	1.30	203	March 19	0.80	63
January 5	.70	74	February 7	1.20	161	March 26	1.00	174
January 7	1.80	170	February 7	1.20	176	April 2	1.50	266
January 10	4.90	1,010	February 13	1.00	66	April 9	1.50	260
January 13	1.70	164	February 18	1.00	63	April 16	.20	62
January 16	1.00	51	February 26	.80	67	April 23	.20	54
January 20	1.10	42	March 5	1.00	215	April 30	.20	44
February 1	2.60	457	March 12	.80	62			

NOTE.—No discharge measurements were made during the remainder of 1907 and 1908.

Daily gage height, in feet, of Little Colorado River at Woodruff, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	1.15	2.8	0.35	1.57	0.35	.....	0.8	3.95	0.1	1.75	0.3
2	.6	1.9	.3	1.45	.25	.....	1.5	3.1	.1	.85	.3
3	.5	1.4	.45	1.35	.15	.....	.9	2.5	.4	.6	.3
4	.4	1.3	.6	1.3	.10	.....	1.2	2.2	.3	.5	.3
5	.75	1.15	.8	1.4	.....	.....	.7	4.0	.5	.55	.3
6	.65	1.1	2.3	1.35	.....	.....	.....	3.05	.5	.45	.3
7	1.3	1.15	2.45	1.4	.....	.....	.....	1.45	.7	.4	.25
8	2.65	1.05	1.3	1.3	.....	.....	.....	1.55	.3	.5	.15
9	2.85	1.05	.9	1.25	.....	1.15	.....	1.8	.05	1.5	.1
10	4.0	1.0	.8	1.2	.....	.15	.....	1.65	.....	1.1	.1
11	2.95	.8	.7	1.15	.....	.....	.....	1.4	.....	.65	.25
12	2.4	.75	.6	1.2	.....	.....	.....	1.2	.....	.5	.2
13	1.4	.75	.5	1.1	.....	.....	.....	1.1	.....	.4	.....
14	1.3	.5	.5	1.1	.....	.....	2.27	2.2	.....	.4	.....
15	1.0	.35	.5	1.1	.....	.....	1.55	1.1	.....	.4	.....
16	1.0	.2	.45	1.1	.....	.....	.6	.9	.....	.5	.15
17	1.15	.25	.5	1.05	.....	.....	.4	.9	.....	.75	.25
18	1.25	.3	.4	.95	.....	.....	.3	.75	1.0	.95	.1
19	1.1	.6	.4	.9	.....	.....	.7	.8	1.7	1.9	.15
20	1.1	.55	.4	.6	.....	.....	1.05	.85	1.0	1.0	.1
21	1.0	.7	.4	.2	.....	.....	1.0	.65	.35	.55	.3
22	1.0	.5	.4	.15	.....	.....	2.35	.7	.2	.4	.1
23	.8	.4	7.65	.45	.....	.....	1.75	.55	1.9	.4	.1
24	.7	.35	2.95	.58	.....	.....	1.0	.45	6.0	.3	.....
25	.6	.55	2.15	.58	.....	.....	3.2	.4	3.65	.35	.....
26	.55	.7	1.75	.5	.....	.8	2.35	.4	1.6	.3	.25
27	.5	.6	1.7	.5	.....	.85	7.55	.35	1.15	.3	.2
28	.5	.45	1.75	.5	.....	1.6	4.0	.3	1.1	.3	.25
29	.5	.....	1.8	.45	.....	.6	3.45	.2	1.1	.3	.1
30	1.85	.....	1.75	.45	.15	.2	6.6	.45	.95	.3	.1
31	5.4	.....	1.6	.....	.....	.....	8.5	.....	.9	.....	.1
1908.											
1	.....	.....	.85	.90	.....	.....	1.65	1.65	.....	.....	.....
2	.....	.....	.70	.80	.....	.....	1.85	1.05	.....	.....	.....
3	.....	.....	.55	.80	.....	.....	2.40	3.60	.....	.....	.....
4	.....	4.50	.50	.75	.....	.....	3.65	1.95	.....	.....	1.45
5	.55	3.90	11.50	.60	.....	.....	4.95	1.50	.....	.....	.....
6	.45	1.75	5.75	.40	.....	.....	3.35	1.10	.....	.....	.....
7	.30	1.10	2.00	.40	.....	.....	2.22	.....	.....	.....	.....
8	.10	1.10	1.50	.40	.....	.....	7.00	.....	.....	.....	.....
9	.....	.90	1.40	.65	.....	.....	3.35	.....	.....	.....	.....
10	.....	.80	1.30	.80	.....	.....	3.05	.....	.....	.....	.....
11	.....	.70	1.30	.85	.....	.50	3.85	.....	.....	.....	.....
12	.....	.70	.50	.85	.....	.40	3.90	.....	.....	.....	.....
13	.15	.55	.....	.75	.....	.30	3.00	.....	.....	.....	.....
14	.15	.40	.....	.65	.....	.50	1.50	.....	.....	.....	.....
15	.30	.40	.....	.65	.....	.....	7.50	.....	.....	.....	.....
16	.10	.40	.....	.60	.....	3.65	.85	.....	.....	.....	11.50
17	.10	.40	.....	.65	.....	1.60	2.55	.....	.....	.....	6.15
18	.10	.45	.....	.60	.....	.55	6.95	.....	1.45	.....	4.90
19	.25	.55	.....	.55	.....	2.15	5.55	.....	.40	.....	.10
20	.30	.95	.90	.50	.....	2.05	3.75	.....	.....	.....	.10
21	.40	1.05	1.40	.40	.....	2.15	3.60	.....	.....	.....	.40
22	.25	1.85	1.50	.30	.....	1.20	1.90	.....	.....	.....	.65
23	.30	.64	1.65	.25	.....	.95	1.50	.....	.....	.....	.40
24	.30	2.50	1.40	.30	.....	.....	1.25	.....	.....	.....	.05
25	.30	1.65	1.40	.20	.....	.....	.95	.....	.....	.....	.....
26	.30	1.50	1.30	.15	.....	1.70	.55	.....	.....	.....	.....
27	.30	1.40	1.20	.05	.....	2.25	5.45	.....	.....	.....	.....
28	.30	1.05	1.20	.....	.....	2.90	6.15	.....	.....	.....	.....
29	.20	1.10	1.20	.....	.....	3.65	2.75	.....	.....	.....	.....
30	.20	.....	1.20	.....	.....	3.10	1.80	.....	.....	.....	.....
31	.10	.....	1.00	.....	.....	2.10	1.35	.....	.....	.....	.....

NOTE.—The water surface was below the gage for all missing days of 1907 and 1908.

Daily discharge, in second-feet, of Little Colorado River at Woodruff, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	55	515	45	285	30	16	51	55	62	62	.....
2	50	330	50	266	25	17	80	60	62	60	.....
3	40	220	80	260	20	18	95	63	62	58	.....
4	30	200	120	260	10	19	55	70	63	56	.....
5	74	150	175	265	.....	20	42	65	63	50	.....
6	60	160	550	260	.....	21	40	67	63	40	.....
7	170	168	485	265	.....	22	40	64	63	30	.....
8	385	150	225	260	.....	23	40	60	1,810	54	.....
9	425	125	130	260	.....	24	40	55	560	70	.....
10	790	115	100	240	.....	25	40	65	400	70	.....
11	495	80	70	200	.....	26	40	67	174	50	.....
12	350	66	62	200	.....	27	40	65	170	50	.....
13	115	66	62	150	.....	28	40	50	175	50	.....
14	100	65	62	140	.....	29	40	.....	180	44	.....
15	56	63	62	100	.....	30	310	.....	175	44	.....
						31	1,030	.....	160	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Colorado River at Woodruff, Ariz., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	[a] 1,180	30	168	10,300
February	[a] 545	50	117	6,500
March	[a] 1,990	45	210	12,900
April	285	30	140	8,330

[a] Maximum recorded discharge for the month. These occurred on January 31, February 1, and March 23.

LITTLE COLORADO RIVER AT HOLBROOK, ARIZ.

This station, which was established March 17, 1905, to determine the amount of water available for irrigation, was discontinued December 31, 1908. It is located at the county bridge across Little Colorado River at Holbrook, Ariz.

The bed of the stream is sandy and shifting, and frequent discharge measurements are required to properly determine the daily flow.

The results presented in the following tables were furnished by the United States Reclamation Service:

Discharge measurements of Little Colorado River at Holbrook, Ariz., in 1907.

[By Conner and Wakefield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 2	4.70	167	February 28	5.10	124	April 5	5.00	550
January 6	4.80	302	March 4	5.00	141	April 8	5.00	573
January 11	4.90	149	March 6	5.20	254	April 12	5.00	329
January 15	5.00	374	Do	5.90	960	April 15	5.00	320
January 20	4.80	206	March 11	4.80	217	April 19	5.00	329
January 25	4.70	91	March 15	4.80	136	April 22	5.00	294
February 3	5.10	371	Do	4.70	115	April 26	5.00	298
February 8	5.00	190	March 18	4.90	124	April 29	5.00	352
February 14	5.00	73	March 22	4.80	115	May 3	5.00	322
February 20	5.10	120	March 25	5.20	824	July 19	5.10	618
February 22	5.00	108	March 29	5.20	832	July 23	5.30	925
February 25	4.80	103	April 1	5.00	547			

NOTE.—No measurements made during the remainder of 1907 and 1908.

Daily gage height, in feet, of Little Colorado River at Holbrook, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.8	5.3	5.0	5.0	5.0	5.0	5.0	4.8	5.7	3.9	4.0	.....
2	4.8	5.3	5.0	5.0	4.9	4.75	4.75	5.8	5.45	3.8	4.0	.....
3	4.8	5.1	5.0	5.0	4.9	4.7	4.7	7.0	5.0	3.8	4.0	.....
4	4.8	5.1	5.0	5.0	4.9	4.6	4.6	6.6	5.0	3.8	4.0	.....
5	4.8	5.05	5.1	5.0	4.85	4.6	4.6	6.65	5.5	3.8	4.0	.....
6	4.8	5.0	5.65	5.0	4.8	4.6	4.6	5.0	5.0	4.75	4.0	.....
7	4.8	5.0	5.8	5.0	4.75	4.6	4.0	5.0	5.0	3.7	4.0	.....
8	5.0	5.0	5.65	5.0	4.7	4.6	4.0	4.9	5.0	3.7	5.0	.....
9	5.0	5.1	4.8	5.0	4.7	4.6	4.5	4.7	5.0	3.7	4.9	.....
10	5.6	5.15	4.8	5.1	4.7	4.6	4.9	4.6	4.9	3.65	4.5	.....
11	6.35	5.1	4.8	5.1	4.7	4.6	4.65	4.6	4.8	3.6	4.4	.....
12	5.3	5.1	4.8	5.0	4.6	4.6	4.45	4.6	4.6	3.6	4.4	.....
13	5.1	5.05	4.7	5.0	4.55	4.6	4.4	5.0	6.0	3.6	4.4	.....
14	5.0	5.0	4.7	5.0	4.45	4.6	4.2	5.0	5.0	3.6	4.4	.....
15	5.0	5.0	4.7	5.0	4.4	4.6	4.0	5.0	4.8	5.0	4.4	.....
16	5.0	5.0	4.7	5.0	4.4	4.6	4.0	5.0	4.8	5.0	4.4	.....
17	5.0	5.0	4.9	5.0	4.4	4.6	4.0	5.0	4.7	5.3	4.4	.....
18	5.0	5.0	4.9	5.0	4.4	4.6	4.0	5.0	4.7	5.05	5.0	.....
19	4.75	5.0	4.85	5.0	4.3	5.0	4.0	5.0	4.65	4.8	4.9	.....
20	4.8	5.1	4.8	5.0	4.3	4.9	5.0	5.0	4.6	4.55	4.8	.....
21	4.8	5.0	4.8	5.2	4.3	4.8	4.7	5.0	4.6	4.5	4.75	.....
22	4.8	5.0	4.8	5.15	4.3	4.7	4.65	5.0	4.5	4.0	5.0	.....
23	5.0	5.0	6.7	5.0	4.2	4.55	4.5	5.0	4.4	3.0	4.9	.....
24	5.0	4.9	5.7	5.0	4.2	4.45	4.4	5.0	4.3	8.0	4.8	.....
25	5.0	4.8	5.2	5.0	4.2	4.35	4.4	6.6	4.1	8.0	4.75	.....
26	5.0	4.8	5.1	5.0	4.2	4.2	5.0	6.0	4.05	7.0	4.65	.....
27	5.0	5.2	5.3	5.0	4.2	4.05	5.0	6.8	4.0	6.4	4.65	.....
28	5.0	5.1	5.3	5.0	4.2	4.0	4.9	6.0	4.0	6.0	4.5	.....
29	5.0	.....	5.2	5.0	4.2	4.0	4.8	6.0	4.0	5.0	4.45	.....
30	5.0	.....	5.2	5.0	4.6	4.0	4.8	6.0	4.0	4.0	4.4	.....
31	6.0	.....	5.1	.....	5.0	.....	4.8	.....	.....	4.0	.....	.....
1908.												
1	4.3	4.7	4.5	4.0	3.6	2.5	1.6	4.0	.....	4.7	3.8	3.3
2	4.55	4.7	4.4	4.0	3.8	2.45	1.6	5.0	.....	4.6	3.75	3.3
3	5.0	4.7	4.4	4.5	4.0	2.45	1.6	4.5	.....	4.6	3.7	3.6
4	4.8	4.7	4.4	5.0	3.9	2.45	1.6	4.5	.....	4.5	3.7	3.9
5	4.7	5.2	6.3	5.0	3.8	2.45	1.6	4.5	.....	4.5	3.65	4.0
6	4.6	5.4	5.3	5.0	3.7	2.45	1.6	4.5	.....	4.3	3.6	4.0
7	4.5	5.0	5.3	4.8	3.6	2.0	1.6	5.0	.....	4.15	3.55	4.0
8	4.4	5.0	4.9	4.8	3.6	2.0	1.6	7.0	.....	4.0	3.5	3.9
9	4.3	5.0	4.8	4.8	3.6	2.0	1.6	7.0	.....	4.0	3.45	3.9
10	4.2	5.0	4.8	5.05	3.6	1.9	1.6	7.0	.....	4.0	3.35	3.7
11	4.2	5.3	4.65	5.3	3.5	1.9	1.6	7.0	.....	4.5	3.2	3.6
12	4.2	5.5	4.5	5.0	3.4	1.9	1.6	5.0	.....	5.0	3.3	3.6
13	4.2	5.15	4.35	5.0	3.4	1.8	1.6	5.5	.....	5.4	3.3	3.6
14	4.2	5.6	4.2	4.8	3.4	1.6	1.6	5.5	.....	5.4	3.3	3.8
15	4.4	5.4	4.1	4.65	3.4	1.6	1.6	5.5	.....	5.0	3.25	4.7
16	4.4	5.4	4.3	4.5	3.4	1.6	1.6	5.6	.....	4.9	3.2	6.5
17	4.4	5.0	4.0	4.25	3.4	1.6	1.6	6.5	.....	4.8	3.15	5.5
18	4.4	5.0	4.3	4.35	3.4	1.6	4.5	7.0	.....	5.8	3.0	4.6
19	4.4	5.0	4.0	4.1	3.4	1.6	3.0	6.5	.....	5.8	3.0	4.4
20	4.4	5.0	4.0	4.0	3.4	1.6	3.4	4.5	4.8	5.4	3.0	4.3
21	4.4	5.0	4.0	4.0	3.4	1.6	3.8	4.0	4.8	5.0	3.0	4.1
22	4.6	7.3	4.0	4.0	3.4	1.6	4.4	4.0	4.8	4.9	3.0	4.0
23	4.8	7.1	4.0	4.0	3.4	1.6	5.2	.....	4.8	4.7	3.0	4.0
24	4.8	6.3	4.0	4.5	3.0	1.6	5.0	.....	4.2	4.4	3.0	3.9
25	4.8	5.3	4.0	4.0	3.0	1.6	3.9	.....	5.4	4.4	3.3	3.8
26	4.8	5.0	4.75	4.0	3.0	1.6	3.8	.....	5.2	4.4	3.3	3.8
27	4.8	4.8	5.3	3.9	3.0	1.6	3.8	.....	5.0	4.4	3.3	.....
28	4.8	4.6	5.0	3.8	2.9	1.6	3.8	.....	5.0	4.4	3.3	.....
29	4.8	4.6	4.0	3.8	2.9	1.6	3.8	.....	4.7	3.9	3.3	.....
30	4.8	.....	4.0	3.7	2.9	1.6	4.0	.....	4.7	3.8	3.3	.....
31	4.75	.....	4.0	.....	2.5	.....	5.0	.....	.....	3.8	.....	.....

Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	160	380	120	547	16	370	85	115	320
2	167	380	125	550	17	360	90	124	325
3	210	374	130	550	18	350	95	124	325
4	240	370	141	550	19	250	100	122	329
5	270	280	220	550	20	206	119	121	330
6	302	190	607	550	21	200	110	118	340
7	300	190	900	560	22	180	108	115	294
8	300	190	600	573	23	180	106	1,800	290
9	300	190	300	550	24	150	105	1,200	295
10	400	190	250	540	25	110	103	824	295
11	700	180	217	460	26	91	103	800	298
12	600	170	200	321	27	90	300	840	300
13	500	130	180	320	28	90	123	840	320
14	400	73	160	320	29	100	.....	832	352
15	374	80	136	320	30	100	.....	800	350
					31	500	.....	700	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Colorado River at Holbrook, Ariz., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	[a] 1,000	90	276	17,000
February	380	73	176	9,780
March	[a] 2,100	115	444	27,300
April	573	290	401	23,900

[a] Maximum recorded discharge for the month. These occurred on January 11 and March 23.

SILVER CREEK AT SNOWFLAKE, ARIZ.

This station, which was established May 4, 1906, to determine the amount of water available for irrigation, is located at the southeast end of the town of Snowflake, Ariz., and 2 miles below the dam of Snowflake and Taylor Irrigation Company. All water is shut off by the dam during the entire irrigation season, except when rains occur.

Owing to shifting conditions of channel, frequent measurements are required to properly determine the relation between discharge and stage.

The discharge measurements taken on Silver Creek near Snowflake in 1907 show no relation to the gage heights; hence it is impossible to make a rating table or curve of any value for interpolation.

The results published in the following tables are furnished by the United States Reclamation Service:

Discharge measurements of Silver Creek River at Snowflake, Ariz., in 1907.

[By Newman, Wakefield, and Conner.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*		*Feet.*	*Sec-ft.*		*Feet.*	*Sec-ft.*
January 4	2.80	15	February 26	1.12	43	March 21	2.00	6
January 9	2.90	25	Do	2.00	145	March 27	2.60	97
January 18	2.90	36	March 5	2.20	196	March 28	2.60	50
January 28	2.70	32	March 6	3.00	101	April 3	2.70	133
February 6	3.20	52	March 13	1.60	14	April 4	2.50	48
February 13	2.00	12	March 14	2.00	10	April 10	2.70	130
February 18	2.00	20	March 20	1.60	21	April 11	2.50	46
February 19	1.00	34						

NOTE.—Zero flow recorded April 17, 18, 24, 25, and May 1 and 2, 1907.

Daily gage height, in feet, of Silver Creek River at Snowflake, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.85	5.35	2.40	2.20	1.60	1.70	1.68	1.78	2.10	1.70	2.30	1.85
2	2.70	3.75	2.50	2.10	1.60	1.73	1.68	2.65	2.10	1.70	2.30	1.85
3	2.70	3.45	2.55	2.22	1.60	1.70	1.65	2.70	3.65	1.70	2.30	1.85
4	2.70	3.40	2.95	2.63	1.60	1.75	1.65	2.40	2.45	1.70	2.30	1.85
5	2.68	3.37	2.97	2.30	1.60	1.75	1.63	2.45	2.25	2.15	2.20	1.85
6	2.72	3.30	5.62	2.07	1.60	1.75	1.60	1.95	2.10	2.08	2.15	1.85
7	2.70	3.20	4.25	2.00	1.60	1.75	1.60	1.80	2.02	1.98	2.12	1.85
8	2.80	3.05	2.70	2.00	1.60	1.75	5.82	1.80	2.05	1.95	2.95	1.85
9	3.45	2.80	2.60	1.87	1.60	1.75	2.20	1.78	2.05	1.95	2.52	1.92
10	6.65	2.65	2.55	1.82	1.60	1.73	1.75	1.75	2.05	1.95	2.20	1.95
11	7.25	2.60	2.37	1.77	1.60	1.70	1.70	1.75	2.02	1.95	2.20	1.95
12	5.60	2.50	2.22	1.75	1.60	1.70	1.70	1.73	2.05	1.95	2.20	1.95
13	4.65	2.30	2.20	1.75	1.60	1.70	1.70	1.70	2.05	1.95	2.20	1.95
14	4.35	2.20	2.15	1.75	1.70	1.70	2.45	1.78	2.15	1.95	2.20	1.95
15	3.77	2.07	2.12	1.72	1.60	1.70	1.98	2.45	2.00	1.95	2.20	1.95
16	2.80	2.05	2.10	1.70	1.60	1.70	1.95	2.10	1.92	1.95	2.15	1.95
17	3.75	2.10	2.08	1.70	1.60	1.70	1.93	1.85	1.90	1.95	2.10	1.95
18	4.72	2.65	2.02	1.65	1.60	1.70	1.93	1.80	1.90	2.50	2.10	1.95
19	4.10	2.77	2.00	1.65	1.60	1.70	1.90	3.15	1.90	2.68	2.10	1.95
20	3.52	2.58	2.00	1.65	1.60	1.70	1.90	2.15	1.85	2.45	2.10	1.95
21	3.47	2.37	2.00	1.65	1.60	1.70	2.18	2.05	1.82	2.35	2.10	1.95
22	3.05	2.35	2.00	1.67	1.60	1.70	2.35	2.00	1.80	2.30	2.05	1.95
23	2.80	2.30	7.00	1.72	1.62	1.70	1.83	1.98	1.80	5.65	2.05	2.00
24	2.75	2.77	5.25	1.77	1.62	1.70	1.80	1.90	1.75	4.75	2.00	2.05
25	2.75	2.65	3.52	1.75	1.60	1.70	1.80	1.90	1.75	3.62	1.95	2.00
26	2.77	2.45	2.90	1.70	1.62	1.70	1.95	1.88	1.70	2.75	1.90	1.98
27	2.78	2.40	2.35	1.67	1.62	1.70	1.97	1.90	1.70	2.55	1.90	1.95
28	2.78	2.40	2.30	1.65	1.65	1.70	1.75	5.25	1.67	2.40	1.85	1.90
29	2.70	.....	2.30	1.62	2.50	1.70	1.70	2.30	1.67	2.32	1.85	1.88
30	2.90	.....	2.30	1.60	2.05	1.70	2.25	5.00	1.70	2.30	1.85	1.90
31	8.60	.....	2.30	.....	1.75	.....	2.00	2.85	.....	2.25	.....	1.90
1908.												
1	1.95	2.05	2.95	2.05	1.80	1.75	1.75	2.10	2.40	1.80	1.90	1.85
2	1.95	2.00	2.90	2.05	1.80	1.75	1.75	3.15	2.50	1.80	1.90	1.85
3	2.00	1.98	2.90	2.00	1.80	1.75	1.75	3.25	3.95	1.80	1.90	2.50
4	2.00	7.00	2.95	2.00	1.80	1.75	1.75	2.28	2.70	1.80	1.90	2.20
5	.....	5.08	.....	2.00	1.80	1.75	1.75	2.20	2.50	1.80	1.90	2.00
6	.....	4.72	6.60	2.00	1.80	1.75	1.75	2.25	2.25	1.80	1.90	2.00
7	.....	4.00	4.35	2.00	1.80	1.75	1.75	2.25	2.15	1.80	1.90	2.00
8	.....	3.40	3.35	2.00	1.80	1.75	1.75	3.88	2.10	1.80	1.90	2.00
9	.....	3.05	3.10	1.95	1.80	1.75	1.75	4.55	2.45	1.80	1.90	1.95
10	.....	2.75	2.75	1.95	1.80	1.75	1.75	5.68	2.65	1.80	1.90	1.95
11	.....	2.55	2.65	1.95	1.80	1.75	1.88	4.15	2.05	1.80	1.90	1.90
12	2.00	2.45	2.45	1.95	1.80	1.75	1.75	3.30	2.00	1.80	1.90	1.90
13	2.05	2.40	2.30	1.95	1.75	1.75	1.75	3.18	2.00	1.80	2.00	1.85
14	2.10	2.32	2.25	1.95	1.75	1.75	1.75	3.00	2.00	1.80	2.00	1.85
15	2.10	2.30	2.20	1.95	1.75	1.75	1.75	3.00	2.00	1.80	1.98	1.85
16	2.10	2.22	2.20	1.95	1.75	1.75	5.10	3.00	2.00	1.80	1.95	2.50
17	2.10	2.15	2.20	1.95	1.75	1.75	2.88	4.50	2.00	1.80	1.90	8.00
18	2.10	2.20	2.15	1.95	1.75	1.75	2.40	5.95	2.00	2.10	1.90	4.90
19	2.10	2.25	2.15	1.85	1.75	1.75	2.28	7.38	1.90	2.38	1.90	4.40
20	2.10	2.25	2.15	1.85	1.75	1.75	2.10	4.02	1.90	2.35	1.85	4.50
21	2.10	2.25	2.15	1.80	1.75	1.75	2.10	3.12	1.90	2.25	1.80	4.10
22	2.10	8.95	2.15	1.80	1.75	1.75	2.10	2.78	1.85	2.22	1.80	3.70
23	2.10	7.00	2.10	1.80	1.75	1.75	2.10	2.65	1.80	2.18	1.80	3.30
24	2.10	6.05	2.10	1.80	1.75	1.75	2.00	2.65	1.80	2.15	1.80	2.90
25	2.10	4.40	2.10	1.80	1.75	1.75	2.00	2.82	1.80	2.15	1.80	2.50
26	2.05	3.70	2.10	1.80	1.75	1.75	2.20	6.00	1.80	2.10	1.90	2.10
27	2.05	3.45	2.10	1.80	1.75	1.75	3.10	3.95	1.80	2.10	2.00	.....
28	2.10	3.20	2.10	1.80	1.75	1.75	2.90	3.00	1.80	1.58	2.00	.....
29	2.18	3.08	2.10	1.80	1.75	1.75	2.35	2.80	1.80	1.98	2.00	.....
30	2.10	.....	2.10	1.80	1.75	1.75	2.25	2.50	1.80	1.90	1.90	.....
31	2.10	.....	2.10	.....	1.75	.....	2.10	2.50	.....	1.90	.....	.....

CHEVELON FORK NEAR WINSLOW, ARIZ.

This station, which was established December 18, 1905, to determine the amount of water available for irrigation, was discontinued December 13, 1908. It was located above the mouth of the river, in sec. 34, T. 18 N., R. 17 E., 19 miles east of Winslow, Ariz.

Conditions of flow are changeable, requiring frequent measurements to properly determine the daily discharge.

The results published in the following tables were furnished by the United States Reclamation Service.

Discharge measurements of Chevelon Fork near Winslow, Ariz., in 1907.

[By Newman, Wakefield, and Conner.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 12	2.6	56	February 23	1.76	132	April 6	.....	149
January 19	1.7	35	March 2	1.76	151	April 13	.....	33
January 26	1.2	23	March 9	4.0	485	April 20	.....	18
February 2	3.2	567	March 16	1.5	99	April 27	.0	24
February 9	2.7	301	March 23	2.9	1,010	May 4	—.2	34
February 16	2.0	83	March 30	.....	128			

NOTE.—No measurements made after May 4, 1907.

Daily gage height, in feet, of Chevelon Fork near Winslow, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.4	3.4	1.4	.....	−0.2	−0.8	2.6	2.3	2.5	2.2	3.3	3.6
2	1.1	3.2	1.4	.....	− .2	− .8	2.6	2.3	2.5	2.2	3.2	3.4
3	1.2	3.0	1.4	.....	− .2	− .8	2.6	2.3	3.8	2.2	3.6	3.2
4	1.0	2.6	1.5	.....	− .2	− .8	2.6	2.3	3.6	2.3	3.6	3.2
5	1.5	2.6	2.0	.....	− .3	− .9	2.6	2.3	2.9	2.3	3.5	3.1
6	1.4	3.0	3.6	.....	− .3	− .9	2.6	2.3	2.8	2.3	3.4	3.1
7	1.2	3.0	4.1	.....	− .4	2.6	2.6	2.3	2.7	2.3	3.3	3.0
8	1.3	2.9	2.4	.....	− .4	2.6	2.6	2.5	2.6	2.3	3.1	2.9
9	1.3	2.5	2.0	.....	− .4	2.6	2.6	2.5	2.5	2.3	3.1	2.8
10	1.2	2.3	2.4	.....	− .5	2.6	2.6	2.3	2.3	2.3	3.0	2.8
11	2.0	2.2	2.2	.....	− .5	2.6	2.6	2.3	2.2	2.3	2.9	2.7
12	2.6	2.0	2.0	.....	− .5	2.6	2.6	2.3	2.2	2.3	2.8	2.6
13	2.6	1.8	2.0	.....	− .6	2.6	2.6	2.6	2.2	2.3	2.7	2.6
14	2.2	1.7	1.9	0.4	− .6	2.6	2.4	2.8	2.2	2.3	2.6	2.5
15	1.8	1.8	1.7	.3	− .6	2.6	2.4	2.9	2.2	2.3	2.8	2.5
16	2.0	2.0	1.5	.3	− .7	2.6	2.4	3.0	2.2	2.3	2.8	2.4
17	2.0	1.4	1.4	.3	− .7	2.6	2.4	2.9	2.2	2.3	2.9	2.4
18	1.9	1.2	1.3	.3	− .7	2.6	2.4	2.7	2.2	2.7	3.5	2.4
19	1.6	1.2	1.8	.3	− .7	2.6	2.4	2.6	2.2	2.6	3.0	2.3
20	1.5	1.2	2.0	.3	− .7	2.6	2.4	2.5	2.2	2.5	2.7	2.3
21	1.2	1.2	2.0	.2	− .7	2.6	2.4	2.7	2.2	2.5	2.6	2.2
22	1.2	1.2	1.9	.2	− .7	2.6	2.4	2.7	2.2	2.5	2.5	2.3
23	1.3	1.2	1.9	.2	− .7	2.6	3.5	2.6	2.2	3.7	2.5	2.3
24	1.2	4.2	13.4	.1	− .7	2.6	2.7	2.5	2.2	3.4	2.9	2.3
25	1.2	3.0	13.2	.1	− .7	2.6	2.5	2.4	2.2	5.2	3.4	2.3
26	1.2	2.2	.....	.0	− .7	2.6	2.3	2.4	2.2	4.8	3.4	2.3
27	1.1	1.8	.....	.0	− .7	2.6	2.3	2.4	2.2	4.2	3.3	2.3
28	1.1	1.5	.....	− .1	− .7	2.6	2.3	2.4	2.2	4.0	3.2	2.3
29	1.1	.....	.....	− .1	− .7	2.6	2.3	2.4	2.2	3.7	3.1	2.2
30	1.1	.....	.....	− .1	− .7	2.6	2.3	3.1	2.2	3.8	3.5	2.2
31	1.1	.....	.....	.....	− .7	.....	2.3	2.7	.....	3.4	.....	2.2

Daily gage height, in feet, of Chevelon Fork near Winslow, Ariz., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	2.2	2.3	5.5	6.1	6.7	7.6	5.5	4.5	4.3	5.0	3.8	3.6
2	2.2	2.3	5.5	6.1	6.7	7.7	6.2	4.5	4.0	5.0	3.8	3.6
3	2.3	2.3	5.2	6.0	6.8	7.7	6.8	4.3	3.8	5.0	3.8	3.0
4	2.2	2.3	5.0	6.1	6.9	7.7	6.9	4.3	4.2	5.0	3.8	3.4
5	2.3	4.1	19.0	5.2	7.0	7.7	4.9	4.4	4.4	4.9	3.8	3.6
6	2.3	5.0	17.8	5.8	7.0	7.8	4.8	4.2	4.6	4.9	3.8	3.6
7	2.3	4.7	14.1	6.2	6.4	7.6	4.8	4.3	4.6	4.9	3.8	3.7
8	2.3	4.5	11.2	6.4	6.1	6.6	4.8	4.4	4.8	4.8	3.8	3.8
9	2.3	4.3	9.0	6.6	6.2	6.6	4.7	4.5	4.4	4.8	3.8	3.7
10	2.3	4.2	8.4	6.6	6.5	6.7	4.7	4.5	4.5	4.8	3.8	3.7
11	2.3	4.0	7.3	6.7	6.6	6.7	4.5	4.5	4.6	4.8	3.8	3.7
12	2.3	3.9	6.6	6.7	6.7	6.7	4.4	4.6	4.6	4.8	3.8	3.7
13	2.3	3.8	6.2	6.8	6.8	6.8	4.4	4.7	4.8	4.8	3.8	.....
14	2.3	3.9	6.0	6.8	6.9	6.8	4.1	4.8	5.0	4.8	3.8	.....
15	2.3	4.0	5.8	6.9	7.0	6.6	4.4	4.9	5.0	4.8	3.8	.....
16	2.3	3.8	5.6	6.9	7.1	6.6	4.4	4.9	5.0	4.8	3.7	.....
17	2.3	3.7	5.4	7.0	7.2	6.6	4.6	4.2	5.0	4.8	3.7	.....
18	2.3	3.7	5.4	7.0	7.3	6.6	4.5	4.5	5.0	4.9	3.7	.....
19	2.3	3.6	5.6	7.0	7.4	6.6	4.5	4.7	5.0	4.4	3.7	.....
20	2.3	3.6	5.8	7.0	7.5	6.6	4.5	4.2	5.0	4.2	3.7	.....
21	2.3	3.6	6.1	7.0	7.5	6.8	4.5	3.4	5.0	4.2	3.7	.....
22	2.3	3.6	6.3	7.0	7.5	6.8	4.5	3.5	5.0	4.0	3.7	.....
23	2.3	3.6	6.5	7.0	7.4	6.8	4.5	3.8	5.0	4.0	3.7	.....
24	2.3	5.0	6.5	7.0	7.5	6.8	4.5	4.0	5.0	4.0	3.7	.....
25	2.3	5.1	6.6	7.0	7.5	6.8	4.5	4.0	5.0	4.0	3.7	.....
26	2.3	4.8	6.6	7.0	7.5	6.9	4.5	3.9	5.0	3.9	3.7	.....
27	2.3	4.8	6.6	7.0	7.5	6.8	4.4	4.0	5.0	3.9	3.7	.....
28	2.3	5.2	6.6	6.8	7.6	5.7	4.3	4.1	5.0	3.9	3.7	.....
29	2.3	5.5	6.6	6.8	7.6	5.6	4.4	4.0	5.0	3.9	3.7	.....
30	2.3	.....	6.6	6.8	7.6	5.4	4.5	4.0	5.0	3.9	3.7	.....
31	2.3	.....	6.2	.....	7.6	.....	4.5	4.2	.....	3.9	.....	.....

CLEAR CREEK NEAR WINSLOW, ARIZ.

This station, which was established June 13, 1906, to determine the quantity of water available for irrigation, is located 6 miles from Winslow and 3 miles above the Clear Creek Irrigation Company's dam and the county bridge. It is one-half mile above the pump house. The bed of the stream is strewn with large bowlders and is permanent.

The results given in the following tables were furnished by the United States Reclamation Service.

Discharge measurements of Clear Creek near Winslow, Ariz., in 1907.

[By R. M. Imel.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
February 2	8.00	1,510	February 23	5.04	552	March 2	5.04	583
February 20	6.00	843	February 25	8.04	1,750	March 9	6.80	1,110

Daily gage height, in feet, of Clear Creek near Winslow, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.2	8.0	5.6	4.6	2.6	2.0	2.0	3.8	2.6	2.3	2.3	2.3
2	3.9	8.0	4.6	6.3	2.5	2.0	2.0	3.6	2.6	2.3	2.3	2.3
3	3.6	6.6	4.2	8.8	2.4	2.0	2.0	3.4	2.8	2.3	2.3	2.3
4	3.4	6.3	4.0	7.4	2.3	2.0	2.0	3.2	3.2	2.6	2.3	2.3
5	3.4	6.0	4.3	6.4	2.4	2.0	2.0	3.2	3.3	2.6	2.3	2.3
6	3.8	6.4	6.5	6.2	2.4	2.0	2.0	3.1	3.2	2.4	2.3	2.3
7	3.5	6.8	10.3	5.8	2.3	2.0	2.0	3.1	3.2	2.3	2.3	2.3
8	3.5	6.8	7.9	5.5	2.2	2.0	2.0	3.0	3.1	2.3	2.3	2.3
9	3.4	6.5	6.7	5.4	2.2	2.0	2.0	3.0	2.8	2.3	2.3	2.3
10	3.4	6.1	5.8	5.4	2.2	2.0	2.0	2.8	2.3	2.3	2.3	2.3
11	3.4	5.7	5.2	5.1	2.2	2.0	2.0	2.6	2.2	2.3	2.3	2.3
12	4.7	5.5	4.7	4.9	2.2	2.0	2.0	2.5	2.2	2.3	2.3	2.3
13	5.3	5.2	4.6	4.6	2.2	2.0	2.0	2.5	2.2	2.3	2.3	2.3
14	5.0	5.0	4.5	4.3	2.2	2.0	2.0	2.5	2.2	2.3	2.3	2.3
15	4.5	4.8	4.2	4.0	2.2	2.0	2.0	2.5	2.3	2.4	2.3	2.3
16	4.2	4.7	3.9	3.8	2.2	2.0	2.0	2.5	2.3	2.3	2.3	2.3
17	4.0	4.7	3.8	3.6	2.2	2.0	2.0	2.5	2.3	2.2	2.3	2.4
18	3.8	4.8	3.8	3.4	2.2	2.0	2.0	2.5	2.3	2.2	2.3	2.4
19	3.7	7.7	4.5	3.2	2.2	2.0	2.0	2.5	2.3	2.3	2.3	2.4
20	3.7	6.7	5.8	3.0	2.2	2.0	2.0	2.6	2.3	2.3	2.3	2.4
21	3.6	6.0	6.6	3.0	2.1	2.0	3.0	2.6	2.3	2.3	2.3	2.4
22	3.6	5.8	7.8	3.0	2.1	2.0	2.2	2.6	2.3	2.3	2.3	2.3
23	3.5	13.7	9.2	3.0	2.1	2.0	2.1	2.6	2.3	2.3	2.3	2.3
24	3.5	16.0	10.0	2.9	2.1	2.0	2.0	2.6	2.3	2.3	2.3	2.3
25	3.4	10.0	7.9	2.8	2.1	2.0	2.0	2.6	2.3	2.3	2.3	2.3
26	3.3	8.4	7.1	2.7	2.1	2.0	2.0	2.6	2.3	2.3	2.3	2.3
27	3.4	7.2	6.4	2.6	2.0	2.0	2.0	2.6	2.3	2.3	2.3	2.3
28	3.4	6.4	5.7	2.6	2.0	2.0	2.0	2.6	2.3	2.3	2.3	2.3
29	3.4	.....	5.2	2.6	2.0	2.0	2.0	2.6	2.3	2.3	2.3	2.3
30	3.5	.....	5.1	2.6	2.0	2.0	2.0	2.6	2.3	2.3	2.3	2.3
31	3.6	.....	4.8	.....	2.0	.....	2.0	2.6	.....	2.3	.....	2.3
1908.												
1	2.4	2.3	6.6	4.6	4.2	2.3	2.0	2.4	3.4	2.2	2.1	2.1
2	2.4	2.3	6.0	4.6	4.1	2.3	2.0	2.4	3.4	2.2	2.1	2.1
3	2.4	2.3	5.5	4.6	4.0	2.3	2.0	2.6	3.4	2.2	2.1	2.1
4	2.4	2.3	5.2	4.7	3.9	2.3	2.0	2.5	3.3	2.2	2.1	2.1
5	2.3	2.3	20.0	5.8	3.8	2.3	2.0	2.5	3.3	2.2	2.1	2.1
6	2.3	2.3	13.6	5.7	3.8	2.3	2.0	2.5	3.3	2.2	2.1	2.1
7	2.3	2.3	9.4	5.3	3.7	2.3	2.0	2.4	3.3	2.2	2.1	2.1
8	2.3	5.3	8.0	5.1	4.0	2.3	2.0	2.4	3.3	2.2	2.1	2.1
9	2.3	5.2	6.4	4.9	4.8	2.3	2.0	2.4	3.3	2.2	2.1	2.1
10	2.3	4.9	5.9	4.7	4.5	2.3	2.0	2.4	3.3	2.2	2.1	2.1
11	2.3	4.7	5.4	4.6	4.2	2.3	2.0	2.4	3.2	2.2	2.1	2.1
12	2.3	4.6	5.0	4.5	4.2	2.3	2.8	2.3	3.2	2.2	2.1	2.1
13	2.3	4.2	4.8	4.4	4.2	2.3	3.0	2.3	3.1	2.2	2.1	.....
14	2.3	4.0	4.7	4.4	4.1	2.2	5.0	2.3	2.5	2.2	2.1	.....
15	2.3	4.0	4.8	4.4	4.0	2.2	3.4	2.3	2.2	2.2	2.1	.....
16	2.3	3.9	5.6	4.3	3.9	2.1	2.8	2.3	2.2	2.2	2.1	.....
17	2.3	3.8	6.2	4.3	3.6	2.0	2.7	2.3	2.2	2.2	2.1	.....
18	2.3	3.8	6.6	4.2	3.3	2.0	2.6	2.3	2.2	2.1	2.1	.....
19	2.3	3.8	6.6	4.2	2.9	2.0	2.6	2.3	2.2	2.1	2.1	.....
20	2.3	3.7	6.2	4.1	2.6	2.0	2.5	2.3	2.2	2.1	2.1	.....
21	2.3	3.7	5.7	4.1	2.4	2.2	2.5	2.3	2.2	2.1	2.1	.....
22	2.3	3.6	5.3	4.0	2.3	2.2	2.4	2.3	2.2	2.1	2.1	.....
23	2.4	3.7	5.1	4.0	2.3	2.1	2.4	3.5	2.2	2.1	2.1	.....
24	2.4	3.7	5.0	3.9	2.3	2.1	2.3	4.0	2.2	2.1	2.1	.....
25	2.4	5.0	4.7	3.9	2.3	2.1	2.3	3.9	2.2	2.1	2.1	.....
26	2.4	5.4	4.6	4.2	2.4	2.2	2.3	3.9	2.2	2.1	2.1	.....
27	2.3	5.2	4.6	4.8	2.4	2.3	2.3	3.6	2.2	2.1	2.1	.....
28	2.3	5.7	4.6	4.7	2.4	2.3	2.3	3.5	2.2	2.1	2.1	.....
29	2.3	6.4	4.6	4.5	2.4	2.0	2.3	3.5	2.2	2.1	2.1	.....
30	2.3	.....	4.6	4.3	2.3	2.0	2.3	3.4	2.2	2.1	2.1	.....
31	2.3	.....	4.6	.....	2.3	.....	2.3	3.4	.....	2.1	.....	.....

GILA RIVER DRAINAGE BASIN.

DESCRIPTION.

Gila River rises in western and southwestern New Mexico, receiving its waters from mountains having an elevation of from 7,000 to 8,000 feet. At the point where it crosses into Arizona it still has an elevation of 6,000 feet. From this place it flows between mountain ranges, falling rapidly, until at Florence, 180 miles away, it is about 1,500 feet above sea level. At a point about 15 miles above Florence the river emerges upon the plains, through which it winds for about 75 miles before receiving the waters of its principal tributary, the Salt. From the junction of the Salt the Gila continues west and southwest and enters the Colorado at Yuma, Ariz., near the southwest corner of the Territory.

The principal tributaries are San Pedro and Santa Cruz rivers from the south, and San Francisco, Salt,[a] Agua Fria, and Hassayampa rivers from the north.

San Francisco River rises in the southwestern part of Socorro County, N. Mex., and flows southwestward into Graham County, Ariz., where it unites with the Gila. The basin comprises about 2,600 square miles, of which 1,800 square miles are in New Mexico and 800 in Arizona.

San Pedro River rises in the northern part of the Mexican State of Sonora, flows northward for more than 100 miles, and empties into the Gila a few miles below the town of Dudleyville, 45 miles above Florence, Ariz. Rising in a country of very light snowfall, the river depends for the greater part of its water supply on the frequent showers of the rainy seasons. It flows over a sandy bed between high, steep banks, and during the dry season it shrinks to an insignificant stream of clear water which rises and sinks in the sand with the varying depth of bed rock.

The floods of the upper Gila and its tributaries are commonly short and violent, occurring during the months of January and February. A period of high water occurs also usually during the late summer or early fall. The season of low water occurs in June and July.

The drainage basin of the Gila includes 7,000 square miles of merchantable timber land, 11,000 square miles of woodland, of which the San Francisco basin has 1,000 square miles of timber land, 45,000 square miles of land upon which there is no timber, 1,300 square miles of scattered timber, and 300 square miles of open land.

The average annual precipitation over the greater part of the contributory drainage area of Gila and San Francisco rivers in New Mexico is between 10 and 15 inches rising above 20 inches in the high mountains of the headwater region.

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[a] For description of Salt River, see p. 183.

The winters are mild, except in the mountainous sections, and very little ice forms on the rivers.

Irrigation development in New Mexico has been confined chiefly to the bottom lands along the main streams and their tributaries, but the total area irrigated comprises only a very few thousand acres. Excellent opportunities for irrigation exist along both the Gila and the San Francisco. The United States Reclamation Service has made surveys for an irrigation project in the vicinity of Alma, N. Mex. Another promising district is that popularly known as the Lordsburg flat, which extends from Lordsburg, N. Mex., northward to Gila River, a distance of over 20 miles, and comprises over a quarter of a million acres of almost unbroken and very fertile land, at an elevation a little above 4,000 feet. This land could be irrigated by the stored water of Gila River, although the expense of reaching it would be considerable.

Good storage sites exist at various places along San Francisco and Gila rivers, among which may be mentioned the reservoir site on the San Francisco near Alma, and that on the Gila near Redrock, N. Mex.

Because of the torrential character of the Gila, water-power development is not feasible except where stored water is used. The San Francisco being more of a mountain stream, presents better opportunities for the use of water power along its upper reaches. Most of the future water-power development along these streams will probably be in connection with irrigation projects. At present it is limited to one or two small plants on the San Francisco.

The following stations have been maintained in this river basin:

Gila River near Cliff, N. Mex., 1904–1907.
Gila River near Redrock, N. Mex., 1908.
Gila River at San Carlos, Ariz., 1899–1905.
Gila River near Buttes, Ariz., 1889–1890, and 1895–1899.
Gila River at Dome (Gila City), Ariz., 1903–1906.
San Francisco River at Alma, N. Mex., 1904–1907.
San Pedro River at Charleston, Ariz., 1904–1906.
San Pedro River near Dudleyville, Ariz., 1890.
Santa Cruz River near Nogales, Ariz., 1907.
Santa Cruz River and ditches at Tucson, Ariz., 1905–1907.
Salt River at Roosevelt, Ariz., 1901–1907.
Salt River at McDowell, Ariz., 1895–1898, 1900–1903.
Salt River below mouth of Cherry Creek, near Roosevelt, Ariz., 1906.
Salt River at Arizona Dam, Ariz., 1888–1891.
Tonto Creek at Roosevelt, Ariz., 1901–1904.
Verde River at McDowell, Ariz., 1889, 1895–1898, 1900–1908.

GILA RIVER NEAR CLIFF, N. MEX.

This station, which was established September 9, 1904, to determine the amount of water available for irrigation was located 9 miles below Cliff post-office, one-half mile below the mouth of Mancos River, and 40 miles from Silver City, N. Mex. It was discontinued December 31, 1907.

Conditions of flow are changeable, and hence frequent measurements are necessary to properly determine the daily discharge.

The results published in the following tables were furnished by the United States Reclamation Service.

Discharge measurements of Gila River near Cliff, N. Mex., in 1907.

[By Frank Asplind.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
October 23	4.50	161	October 26	5.00	374	October 28	4.85	265
October 24	4.90	337	October 27	4.90	312	October 29	4.80	237
October 25	5.10	433						

Daily gage height, in feet, of Gila River near Cliff, N. Mex., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.60	7.05	5.50	5.06	4.90	4.72	4.27	4.55	7.60	4.50	5.00	4.70
2	5.32	6.70	5.40	5.00	4.87	4.68	4.25	4.52	6.40	4.50	4.98	4.70
3	5.12	6.60	5.37	5.18	4.80	4.62	4.23	4.55	6.25	4.50	4.95	4.70
4	4.95	6.30	5.30	5.30	4.75	4.60	4.22	4.55	5.40	4.50	5.00	4.70
5	5.05	6.25	5.27	5.30	4.70	4.60	4.20	4.47	6.60	4.50	5.00	4.70
6	5.62	6.52	5.25	5.20	4.70	4.60	4.95	4.50	7.50	4.50	4.95	4.65
7	5.75	6.52	5.30	5.15	4.70	4.60	4.25	4.50	6.30	4.50	4.90	4.65
8	5.75	6.42	5.30	5.10	4.70	4.55	4.25	4.50	6.10	4.50	4.85	4.65
9	9.00	6.25	5.32	5.10	4.70	4.53	4.30	4.75	6.00	4.45	4.88	4.65
10	8.15	6.15	5.30	5.10	4.65	4.50	4.30	4.60	5.55	4.45	4.90	4.60
11	6.20	6.10	5.27	5.18	4.65	4.48	4.27	4.55	5.45	4.40	4.90	4.52
12	6.20	6.00	5.30	5.28	4.65	4.43	4.37	4.55	5.35	4.40	4.90	4.55
13	5.95	5.95	5.30	5.30	4.65	4.40	4.32	4.55	5.15	4.35	4.90	4.52
14	5.45	5.85	5.30	5.30	4.60	4.40	4.30	4.55	5.10	4.35	4.88	4.50
15	5.45	5.80	5.20	5.28	4.60	4.40	4.45	4.42	4.97	4.35	4.85	4.50
16	10.00	5.77	5.15	5.20	4.60	4.40	4.30	4.40	4.90	4.40	4.80	4.50
17	9.65	5.75	5.15	5.18	4.60	4.40	4.20	4.37	4.90	4.40	4.80	4.50
18	8.45	5.82	5.15	5.10	4.55	4.40	4.20	4.62	4.97	4.40	4.75	4.50
19	7.85	5.85	5.25	5.00	4.60	4.48	4.95	4.87	4.92	4.58	4.80	4.50
20	7.10	5.82	5.35	5.00	4.55	4.50	4.70	4.95	4.80	4.60	4.80	4.45
21	6.65	5.70	5.48	5.00	4.55	4.70	4.60	5.40	4.75	4.60	4.78	4.45
22	6.45	5.70	5.65	5.00	4.55	4.60	4.65	5.10	4.85	4.60	4.75	4.45
23	6.28	5.65	5.72	5.00	4.55	4.52	4.65	5.15	4.80	4.58	4.70	4.45
24	6.18	5.80	5.65	4.98	4.55	4.50	4.75	5.30	4.75	5.00	4.70	4.40
25	6.10	5.70	5.50	4.88	4.55	4.50	4.90	5.25	4.67	5.10	4.68	4.40
26	6.10	5.62	5.40	4.80	4.60	4.50	4.60	7.15	4.65	5.00	4.65	4.40
27	6.10	5.52	5.38	4.78	4.60	4.40	4.70	6.60	4.60	4.92	4.60	4.40
28	6.10	5.50	5.30	4.75	4.65	4.35	4.67	6.67	4.55	4.85	4.68	4.40
29	6.10	.....	5.22	4.80	4.80	4.32	4.62	7.20	4.55	4.80	4.65	4.40
30	6.22	.....	5.25	4.90	4.80	4.30	4.57	7.60	4.50	4.80	4.70	4.40
31	7.70	.....	5.12	.....	4.80	.....	4.63	8.82	.....	4.80	.....	4.40

GILA RIVER NEAR REDROCK, N. MEX.

This station, which was established May 14, 1908, to determine the amount of water available for irrigation and power enterprises, is located about 2 miles east of Redrock post-office and about 300 yards

above the Middle Box Canyon of the Gila. The two nearest railroad points are Silver City about 36 miles east of Redrock, and Lordsburg about 30 miles south.

Mangos River, an intermittent stream, the first large tributary upstream from the station, joins the Gila about 12 miles above. A number of large washes come into the river above and below the station, and during flood stages the run-off from these tributaries is very great. The drainage area at the station is about 3,500 square miles. A number of large irrigation ditches divert water above the station. Practically no power is developed in the headwaters of this basin, although opportunity for such development is good.

Except for fringe ice along the edges of the stream, ice conditions do not interfere with the accuracy of the results.

Neither the location nor the datum of the gage has been changed during the maintenance of the station.

Because of the few discharge measurements, the uncertainty of gage readings, and the constantly shifting channel, results are not good.

Discharge measurements of Gila River near Redrock, N. Mex., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14 [a]	R. L. Cooper	91	107	0.40	208
November 16 [a]	do	140	95	.80	101
December 29 [a]	J. B. Stewart	116	77	1.15	129

[a] Wading measurements.

Daily gage height, in feet, of Gila River near Redrock, N. Mex., for 1908.

[J. L. Rutland, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	1.4	2.0	1.7	0.9	0.8	16	3.1	1.2	1.5	0.6	0.85	0.7
2	.9	1.3	2.4	1.4	.85	.75	17	3.1	1.2	2.6	1.15	.8	.9
3	.9	1.3	1.1	1.3	.85	.7	18	.9	1.6	1.9	.9	.7	.8
4	.9	1.2	1.6	1.3	.8	.7	19	.9	1.4	1.5	.85	.7	.75
5	.9	1.8	1.4	1.2	.75	.65	20	.85	1.3	1.3	.8	.65	.75
6	.9	1.6	1.3	1.15	1.3	.9	21	.8	1.5	1.3	.8	.6	.75
7	.9	1.4	1.3	1.1	1.0	.9	22	.8	1.3	1.6	.75	.6	.75
8	.9	1.3	3.0	.8	.95	.85	23	1.1	1.3	1.5	.9	.9	.7
9	.9	1.3	2.1	1.3	.85	.75	24	1.15	1.2	1.3	.85	.8	.7
10	.9	1.3	1.4	1.0	.8	.7	25	1.0	1.9	1.3	.8	.75	.95
11	.9	2.0	1.6	.8	.8	.7	26	1.5	1.6	1.45	.8	.7	.8
12	.9	1.5	1.3	.75	.75	.85	27	1.5	1.5	3.1	.75	1.5	.75
13	.9	1.3	1.9	.7	.7	.8	28	1.4	1.4	2.3	.7	1.4	.75
14	3.1	1.3	1.4	.7	1.5	.8	29	1.3	1.3	1.6	.7	1.0	.7
15	3.1	1.2	1.3	.6	.9	.7	30	1.2	1.3	1.4	1.1	.8	.7
							31	1.2	1.2	.....	.9	.....	.7

SAN FRANCISCO RIVER AT ALMA, N. MEX.

This station, which was established October 18, 1904, to determine the amount of water available for irrigation was located about

one-half mile south of Alma, N. Mex., and 85 miles northwest of Silver City. It was discontinued December 31, 1907.

Conditions of flow are changeable.

The results published herewith were furnished by the United States Reclamation Service.

Discharge measurements of San Francisco River at Alma, N. Mex., in 1907 and 1908.

[By Frank Asplind.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
January 1	1.95	235	April 24	3.00	121	August 21	3.30	201
January 2	1.80	186	April 25	2.95	106	August 23	2.85	77.5
January 3	1.60	115	April 26	2.95	106	August 24	3.25	184
January 5	1.70	152	April 27	2.92	95	August 26	3.15	151
January 7	2.18	344	April 29	3.10	155	August 28	5.25	1,480
January 8[a]	7.05	4,420	May 1	3.10	156	August 29	5.40	1,640
January 9	5.50	2,150	May 2	3.05	144	August 30[a]	5.55	2,050
January 16[a]	6.70	4,180	May 3	2.95	115	September 2	3.10	128
January 17	3.80	995	May 4	2.95	115	September 4	3.35	194
January 18	4.00	1,180	May 6	2.92	92.0	September 5	3.45	269
January 22	3.80	986	May 8	2.80	75.2	September 7	3.22	171
January 24	3.50	536	May 10	2.80	74.4	September 9	3.15	153
February 5	4.50	812	May 22	2.70	42.5	September 11	2.90	75.7
February 6	4.70	1,050	May 24	2.70	42.3	September 13	2.90	71.1
February 8	4.35	664	May 25	2.70	48.6	September 14	2.80	55.9
February 9	4.10	555	May 28	2.80	69.2	September 17	2.80	56.8
February 11	3.95	481	May 29	2.90	89.6	September 19	2.75	47.5
February 13	3.70	385	May 30	2.90	86.8	September 21	2.72	43.6
February 14	3.65	353	June 1	2.85	77.8	September 23	3.00	102
February 15	3.60	348	June 4	2.75	58.9	September 24	2.90	76.8
February 16	3.65	354	June 5	2.75	58.4	September 26	2.85	65.4
February 18	4.45	810	June 7	2.65	41.8	September 28	2.78	53.0
February 19	3.90	467	June 8	2.65	42.0	October 2	2.70	45
February 20	3.85	446	June 10	2.60	32.2	October 5	2.80	56
February 22	3.75	399	June 12	2.58	27.6	October 8	2.80	58
February 23	4.25	634	June 13	2.58	24.0	October 10	2.80	59
February 25	3.95	482	June 15	2.48	14.1	October 12	2.75	51
February 26	3.80	425	June 17	2.48	14.1	October 15	2.80	58
February 27	3.80	403	June 18	2.90	95.3	October 18	2.85	69
March 1	3.65	323	June 20	2.55	21.5	October 19	2.88	72
March 2	3.65	322	June 21	2.75	51.4	October 23	4.50	161
March 4	3.60	297	June 22	2.75	51.4	October 24	4.90	331
March 6	3.90	450	June 24	2.58	24.2	October 25	5.10	433
March 7	3.75	385	June 27	2.48	9.8	November 1	3.05	136
March 9	3.65	348	June 28	2.45	7.6	November 4	2.85	86
March 11	3.60	298	July 2	2.40	1.4	November 6	2.82	76
March 13	3.50	256	July 5	2.80	60.5	November 8	2.85	87
March 14	3.50	266	July 6	2.70	46.0	November 11	2.88	94
March 15	3.30	220	July 9	2.60	35.7	November 13	2.82	77
March 16	3.35	230	July 10	2.58	31.9	November 16	2.80	65
March 18	3.35	232	July 12	2.55	27.3	November 18	2.88	87
March 19	3.45	264	July 14	3.25	203	November 21	2.82	68
March 21	3.60	312	July 15	2.95	104	November 23	2.88	87
March 22	3.60	309	July 17	2.65	44.3	November 25	2.80	66
March 23	3.75	369	July 19	2.70	52.0	November 27	2.85	80
March 25	3.60	303	July 22	3.00	118	November 29	2.80	63
March 27	3.40	236	July 23	2.90	94.0	December 2	2.80	65
March 28	3.35	221	July 24	2.82	71.9	December 4	2.80	64
March 29	3.25	198	July 25	2.85	79.4	December 6	2.78	59
April 1	3.15	173	July 26	4.20	600	December 7	2.82	73
April 3	3.52	286	July 27	3.20	182	December 9	2.80	67
April 4	3.40	238	July 29	2.82	69.3	December 11	2.85	78
April 5	3.35	217	July 30	2.80	63.4	December 13	2.80	65
April 6	3.25	197	August 1	2.70	48.6	December 16	2.78	59
April 9	3.15	175	August 3	2.90	87.3	December 18	2.80	66
April 10	3.20	188	August 4	4.95	1,260	December 21	2.82	73
April 11	3.15	169	August 5	3.58	781	December 24	2.78	59
April 13	3.18	182	August 8	2.75	58.9	December 27	2.85	73
April 15	3.20	189	August 9	3.05	130	December 30	2.80	64
April 17	3.15	165	August 10	2.80	68.9			
April 18	3.10	160	August 12	2.70	51.0	1908.		
April 19	3.10	158	August 14	2.70	50.4	August 4	.....	570
April 20	3.05	141	August 16	2.62	39.9			
April 23	3.00	121	August 19	3.10	151			

[a] Float measurement.

Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.95	5.10	3.67	3.20	3.10	2.85	2.40	2.75	3.90	2.70	3.05	2.75
2	1.85	4.50	3.62	3.25	3.10	2.80	2.40	3.10	3.20	2.75	3.00	2.80
3	1.62	4.27	3.65	3.45	3.00	2.80	2.40	2.80	3.00	2.80	2.90	2.70
4	1.62	4.25	3.65	3.35	3.00	2.75	2.52	3.90	3.28	2.78	2.85	2.75
5	1.60	4.55	3.67	3.30	2.95	2.75	2.60	3.35	3.40	2.85	2.80	2.75
6	1.67	4.65	3.85	3.25	2.90	2.67	2.65	2.75	3.38	2.80	2.80	2.80
7	1.77	4.45	3.75	3.20	2.90	2.70	2.75	2.85	3.35	2.80	2.80	2.80
8	4.85	4.35	3.80	3.20	2.75	2.65	2.65	2.75	3.15	2.80	2.85	2.80
9	5.48	4.17	3.70	3.15	2.85	2.65	2.60	2.90	3.15	2.80	2.90	2.75
10	4.50	4.05	3.90	3.23	2.90	2.65	2.60	2.85	3.00	2.80	2.90	2.80
11	3.80	3.90	3.60	3.28	2.85	2.55	2.60	2.75	3.00	2.80	2.90	2.80
12	3.60	3.75	3.55	3.28	2.80	2.55	2.60	2.75	2.90	2.80	2.85	2.80
13	3.20	3.67	3.50	3.25	2.80	2.57	2.55	2.70	2.90	2.80	2.80	2.80
14	2.90	3.70	3.45	3.17	2.80	2.55	2.75	2.70	2.90	2.80	2.80	2.80
15	4.52	3.70	3.37	3.15	2.80	2.50	2.85	2.65	2.90	2.80	2.80	2.80
16	5.40	3.67	3.35	3.17	2.80	2.50	2.80	2.60	2.80	2.80	2.90	2.85
17	4.00	3.90	3.32	3.12	2.72	2.50	2.65	2.75	2.80	2.82	2.82	2.80
18	4.10	4.15	3.37	3.17	2.80	2.53	2.65	2.70	2.80	2.88	3.00	2.80
19	3.70	4.00	3.37	3.12	2.80	2.57	2.60	3.10	2.80	2.95	2.90	2.80
20	(*a*)	3.85	3.50	3.07	2.75	2.68	2.65	3.20	2.70	2.90	2.90	2.80
21	.....	3.90	3.65	3.00	2.75	2.80	2.70	3.25	2.85	2.82	2.90	2.80
22	.....	3.90	3.65	3.00	2.70	2.72	2.85	3.10	3.00	2.95	2.85	2.80
23	.....	4.20	3.75	3.10	2.72	2.63	2.90	2.85	2.95	3.25	2.80	2.80
24	(*b*)	4.05	3.75	3.00	2.70	2.60	2.90	2.90	2.90	3.45	2.80	2.80
25	.....	4.10	3.57	3.00	2.70	2.55	2.92	2.95	2.90	3.00	2.75	2.80
26	.....	3.85	3.47	3.00	2.70	2.50	3.90	3.35	2.80	3.00	2.72	2.80
27	3.60	3.65	3.42	2.98	2.70	2.45	3.15	3.10	2.80	2.98	2.85	2.80
28	3.62	3.67	3.37	2.92	2.77	2.45	2.95	3.65	2.78	3.00	2.85	2.80
29	3.65	.....	3.30	3.20	2.90	2.40	2.80	5.85	2.75	2.98	2.78	2.82
30	3.80	.....	3.20	3.15	2.90	2.40	2.80	5.55	2.70	2.85	2.75	2.80
31	5.30	.....	3.18	.....	2.97	.....	2.90	4.30	.....	2.95	.....	2.80

a Channel changed and covered with gravel. *b* New gage.

Daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	225	1,400	360	180	150	80	1	60	465	50	135	60
2	190	800	340	195	150	70	1	160	180	60	120	70
3	120	660	350	270	120	70	1	70	120	70	90	50
4	120	640	350	230	120	60	18	620	205	65	80	60
5	115	850	360	210	105	60	35	240	250	80	70	60
6	140	925	440	195	90	45	40	60	240	70	70	70
7	170	770	390	180	90	50	60	80	230	70	70	70
8	2,690	700	413	180	60	40	40	60	165	70	80	70
9	2,080	600	370	165	80	40	35	95	165	70	90	60
10	1,380	540	465	188	90	40	35	80	120	70	90	70
11	1,000	465	330	202	80	20	35	60	120	70	90	70
12	900	390	310	202	70	20	35	60	90	70	80	70
13	710	360	290	195	70	27	20	50	90	70	70	70
14	575	370	270	172	70	20	400	50	90	70	70	70
15	1,460	370	240	165	70	15	80	40	90	70	70	70
16	2,720	360	230	172	70	15	70	35	70	70	90	80
17	1,100	465	220	158	55	15	40	60	70	75	75	70
18	1,150	590	240	172	70	17	40	50	70	85	120	70
19	940	515	240	158	70	23	35	150	70	105	90	70
20	.....	440	290	138	60	45	40	185	50	90	90	70
21	.....	465	350	120	60	70	50	190	80	75	90	70
22	.....	465	350	120	50	55	80	150	120	105	80	70
23	.....	615	390	150	55	37	90	80	105	210	70	70
24	.....	540	390	120	50	35	90	90	90	242	70	70
25	.....	565	320	120	50	20	97	105	90	120	60	70
26	.....	440	280	120	50	15	540	245	70	120	55	70
27	.....	350	260	112	50	8	165	150	70	112	80	70
28	.....	360	240	98	65	8	105	170	65	120	80	70
29	.....	.....	210	180	90	1	70	2,280	60	98	65	75
30	.....	.....	180	165	90	1	70	2,050	50	80	60	70
31	.....	.....	173	.....	112	.....	90	678	.....	105	.....	70

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of San Francisco River at Alma, N. Mex., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January 1–19	[a] 5,200	115	936	35,300
February	[a] 1,600	350	572	31,800
March	465	173	311	19,100
April	270	98	168	10,000
May	150	50	79.4	4,880
June	80	1	34.1	2,030
July	[a] 970	1	80.9	4,970
August	[a] 3,200	35	273	16,800
September	[a] 515	50	125	7,440
October	[a] 465	50	91.5	5,630
November	135	55	81.7	4,860
December	80	50	68.5	4,210
The period	5,200	1	235	147,000

[a] Maximum recorded discharge for the month. These occurred on January 8, February 1, July 26, August 29, September 31, and October 24.

SANTA CRUZ RIVER NEAR NOGALES, ARIZ.

This station, which was established March 22, 1907, to determine the quantity of water available for irrigation, was located about 5 miles from Nogales, near Yerba Buena ranch. Conditions of flow are subject to change. It was discontinued November 30, 1907. The records given herewith were furnished by the United States Reclamation Service.

Discharge measurements of Santa Cruz River near Nogales, Ariz., in 1907.

[By Anderson and Reed.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
March 22	2.77	12.8	March 25	2.76	8.8	November 3	3.05	143
March 23	2.80	22.4	March 26	3.15	7.6	November 26	3.40	144
March 24	2.80	8.8	April 3	3.70	4.9			

A. FLOOD PASSING OVER ROOSEVELT DAM, SALT RIVER PROJECT, ARIZONA.

B. TRANSMISSION LINE THROUGH SALT RIVER VALLEY, ARIZONA; POWER DEVELOPED AT ROOSEVELT DAM.

Daily gage height, in feet, of Santa Cruz River near Nogales, Ariz., for 1907.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		3.60	3.45		3.75	2.80	2.75	3.10	3.05
2		3.70	3.48	3.75	3.80	2.70	2.60	3.10	3.05
3		3.70	3.45	3.75	3.80	2.60	2.30	3.10	3.05
4		3.62	3.42	3.75	3.70	2.75	2.10	3.10	3.05
5		3.65	3.50	3.80	3.80	2.70	3.35	3.10	3.05
6		3.68	3.50	3.80	3.80	2.75	3.00	3.10	3.05
7		3.58	3.50	3.85	3.80	2.80	3.10	3.05	3.00
8		3.58	3.48	3.75	5.50	2.75	3.20	3.05	3.30
9		3.58	3.46	3.90	2.65	2.60	4.60	3.05	3.35
10		3.58	3.40	3.80	2.40	2.50	4.40	3.05	3.65
11		3.62	3.45	3.60	2.40	2.50	5.10	3.05	3.60
12		3.70	3.45	3.55	4.55	2.45	4.30	3.10	3.60
13		3.66	3.45	3.60	3.00	2.45	3.20	3.10	3.55
14		3.60	3.45	3.60	2.80	2.60	4.10	3.10	3.45
15		3.80	3.45		2.60	2.90	3.00	3.10	3.45
16		3.82	3.48	3.80	2.55	2.70	2.90	3.40	3.45
17		3.78	3.45	3.95	2.48	2.75	4.85	3.40	3.45
18			3.50	3.95	3.77	3.95	3.85	4.05	3.45
19		3.75	3.50	3.90	2.70	3.10	3.95		3.40
20		3.75	3.55	3.95	2.60	3.00	3.90	4.00	3.40
21		3.55	3.65	3.95	2.70	2.95	3.90	4.05	3.40
22	2.77	3.68	3.70	3.98	3.00	3.00	3.80		3.40
23	2.80	3.70	3.70	3.98	3.00	5.25	3.20	3.85	3.40
24	2.80	3.70	3.70	3.98	3.35	4.50	3.10	3.70	3.40
25	2.76	3.72	3.70	3.98	3.25	3.50	3.00	3.50	3.40
26	3.15	3.72	3.70	3.80	3.30	3.20	3.00	3.45	3.40
27	3.50	3.70	3.68	3.75	3.00	3.80	2.90	3.40	3.40
28	3.40	3.80	3.72	3.70	2.95	3.40	2.95	3.35	3.35
29	3.55		3.72	3.70	2.90	3.30	3.05	3.20	3.35
30	3.62		3.75	3.70	2.85	3.10	3.10	3.20	3.35
31	3.40		3.75		2.85	3.00		3.10	

SANTA CRUZ RIVER AND DITCHES AT TUCSON, ARIZ.

This station was established October 15, 1905, and discontinued November 12, 1907. It was located at Congress Street Bridge, Tucson, Ariz.

Manning and Farmers ditches divert practically the entire flow during the low period of Santa Cruz River. These ditches are taken out just above the gaging station, and their flow is determined by current-meter measurements, supplemented by daily records, kept by the ditch managers, of the amount of water contained in each. This water is used to irrigate lands on the north and south sides of Santa Cruz River in and about the vicinity of Tucson.

Conditions of flow are changeable.

The results published herewith were furnished by the United States Reclamation Service.

Discharge measurements of Santa Cruz River at Tucson, Ariz., in 1907.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 14	F. M. Jolly	0.46	16	August 15	L. B. Croasdale.	0.15	66
January 17	F. C. Kelton	4.40	4,010	August 16	do	.01	22
Do	do	3.30	3,330	August 19	do	.20	64
January 18	do	1.95	924	August 21	Croasdale and Callahan.	1.71	911
January 19	do	1.50	633				
February 11	W. L. Handy	.18	10	August 22	do	.78	365
March 4	do	.05	2	Do	do	.25	167
July 25	L. B. Croasdale	2.36	1,410	August 30	do	.21	7
July 29	do	.20	17	September 4	L. B. Croasdale.	1.43	672
August 3	do	2.10	1,100	Do	Croasdale and Kelton.	1.15	588
Do	do	.99	537				
August 4	do	.01	38	September 5	L. B. Croasdale.	.01	93

Discharge measurements of Farmers ditch near Tucson, Ariz., in 1907.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
March 28	F. C. Kelton	9.40	[a] 4.6	July 14	L. B. Croasdale.	7.07	[c] 3.1
May 16	do	8.15	[b] 5.1	December 29	do	[d] 9.33	3.4
June 15	do	9.54	3.4				

[a] At flume crossing river. [b] 300 feet below head-gate. [c] 200 feet below head-gate. [d] New gage.

Discharge measurements of Manning ditch near Tucson, Ariz., in 1907.

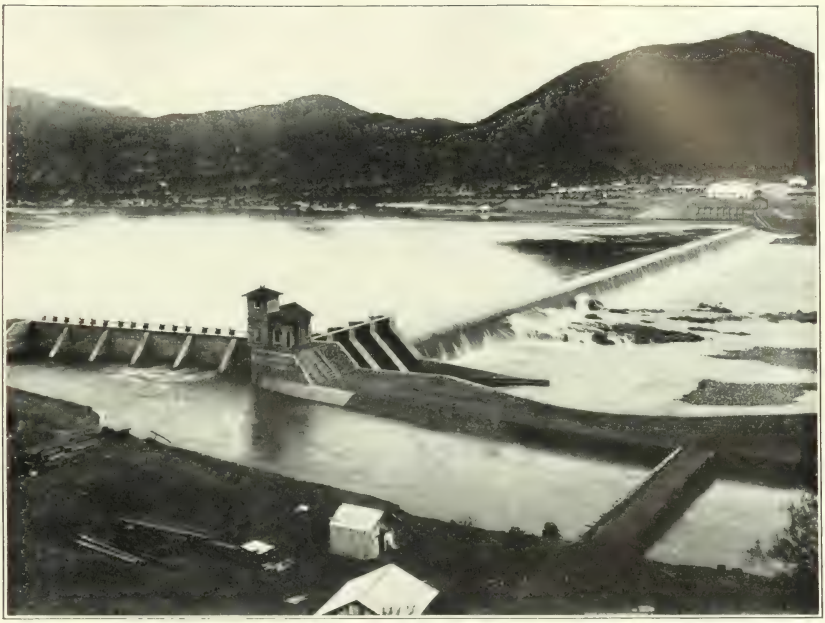
Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
March 28 [a]	F. C. Kelton	8.84	10.7	July 6 [a]	L. B. Croasdale.	8.11	6.5
May 16 [a]	do	8.19	9.5	August 31 [d]	do	6.84	9.9
Do. [a]	do	8.19	9.0	September 1 [e]	do	6.84	10.0
Do. [b]	do	8.94	9.1	Do. [d]	do	6.85	8.3
Do. [b]	do	8.90	8.4	September 28 [d]	do	6.85	8.3
Do. [b]	do	8.88	6.0	November 3 [d]	do	7.02	10.1
Do. [c]	do	9.50	11.4	December 29 [d]	do	6.89	8.8
Do. [c]	do	9.45	11.4	Do. [d]	do	8.19	9.5
June 15 [a]	do	8.05	7.6				

[a] Measurement made at head-gate.
[b] Measurement made 1½ miles below head-gate.
[c] Measurement made 3½ miles below head-gate.
[d] Measurement made 100 feet south of Congress street.
[e] Measurement made at Hospital road flume.

Daily gage height, in feet, of Santa Cruz River at Tucson, Ariz., for 1907.

Day.	Jan.	Feb.	July.	Aug.	Sept.	Oct.	Nov.	Day.	Jan.	Feb.	July.	Aug.	Sept.	Oct.	Nov.
1	0.7	0.4	.....	−0.40	−0.37	.....	−0.27	16	0.85	0.15	.....	−0.04	−0.26	−0.26	.....
2	.5	.4	.....	.....	− .37	.....	− .27	17	3.8	.15	.....	− .26	− .26	.00	.....
3	.5	.4	.....	1.50	.46	.....	− .25	18	1.95	.15	.....	− .40	.00	.25	.....
4	.5	.4	.....	− .05	1.40	.....	− .25	19	1.5	.15	.....	.48	− .28	− .04	.....
5	.5	.3	.....	− .14	− .06	.....	− .25	20	1.5	.1	.....	.43	− .28	− .18	.....
6	.55	.3	.....	− .19	.18	.....	− .25	21	.7	.1	.....	1.56	− .28	− .23	.....
7	.55	.3	.....	− .20	.25	.....	− .25	22	.5	.1	.....	.51	.....	− .30	.....
8	.55	.3	.....	− .24	− .11	.....	− .25	23	.5	.1	.....	.18	.....	− .30	.....
9	.55	.2	.....	− .30	− .24	.....	− .25	24	.5	.1	.....	.50	.....	− .13	.....
10	1.25	.2	.....	− .31	− .28	.....	− .25	25	.5	.1	2.36	.05	.....	− .23	.....
11	.6	.18	.....	.....	.19	.....	− .20	26	.5	.05	.....	− .02	.....	− .27	.....
12	.5	.18	.....	.....	− .13	.....	− .40	27	.5	.05	.....	.16	.....	− .27	.....
13	.5	.18	.....	.....	− .28	−0.26	.....	28	.5	.05	− .20	.53	.....	− .27	.....
14	.5	.18	.....	.....	− .28	− .26	.....	29	.5	.....	− .20	.02	.....	− .27	.....
15	.5	.15	.....	.17	− .18	− .26	.....	30	.5	.....	− .20	− .31	.....	− .27	.....
								31	.5	.....	− .30	.....	.....	− .20	.....

NOTE.—The river was dry March 1 to July 22, August 2, 11–14, 31, September 22 to October 12, and November 12 to December 31.



A. GRANITE REEF DAM, SHOWING BOTH INTAKES, SALT RIVER PROJECT, ARIZONA.

B. MEASURING SECTION ON GRAND RIVER AT GLENWOOD SPRINGS, COLO.

SALT RIVER DRAINAGE BASIN.

DESCRIPTION.

Salt River, though considered a tributary of the Gila, is in fact larger both in catchment area and in discharge. It receives the drainage from central Arizona, its principal tributary, the Verde, flowing southeasterly and south from the mountains and tablelands south of Colorado River. The Verde Valley is situated in Yavapai County, Ariz., on the headwaters of the stream, and extends from a canyon above Camp Verde to a point about 10 miles below the fort. About a mile below the junction of the Verde and 30 miles above Phoenix the Salt enters upon the plains of the Gila Valley.

The Salt River project of the United States Reclamation Service involves the construction of a dam 240 feet high for the storage of 1,100,000 acre-feet of water, and of power plants for pumping water for irrigation in the lower valley. In addition to this it is estimated that by developing the flow available along Salt River and using it for pumping, nearly 60,000 acres can be added to the irrigated district in Salt River valley. The power developed along the river will be transmitted to substations properly located and there distributed at a lower voltage to pumping stations so situated as to furnish water for irrigation. Views of the Roosevelt dam, the Granite Reef dam, and the transmission lines are shown in Plates IX, *A;* X, *A;* and IX, *B*. The Reclamation Service reports the project as 83.5 per cent completed (December, 1909).

SALT RIVER AT ROOSEVELT, ARIZ.

This station, which was established February 7, 1901, to determine the amount of water available for irrigation and was discontinued December 9, 1907, was located at the town of Roosevelt—the United States Reclamation Service construction camp for the Salt River dam and reservoir, and is about 12 miles west of Livingston, Ariz.

During the flood of December 3 to 5, 1906 (Pl. IX, *A*), the gage rod which had been in use since the construction of the dam was begun, was carried away. From December 3 to 15, 1906, the readings were taken on the upper gage about 1,000 feet above the dam. A new rod was established at the same location as the one carried away on December 17, 1906, with the zero at the same elevation as the old gage.

Conditions of flow are changeable, requiring frequent measurements to properly determine the daily discharge.

The results published herewith are furnished by the United States Reclamation Service.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1907.

[By McDonald, Blades, and others.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 3	3.20	892	April 9	4.30	2,210	July 13	2.05	275
January 7	4.60	4,560	April 10	4.40	2,440	July 15	2.00	294
January 8	4.95	4,830	April 11	4.50	2,510	July 16	2.05	299
January 9	5.55	5,380	April 12	4.50	2,520	July 17	2.05	285
January 10	6.70	9,030	April 13	4.50	2,550	July 18	2.00	277
January 11	6.05	8,100	April 15	4.40	2,370	July 19	2.00	265
January 12	5.12	5,270	April 16	4.30	2,200	July 20	2.00	262
January 14	4.25	2,580	April 17	4.20	2,000	July 22	2.22	367
January 15	3.80	2,110	April 18	4.00	1,870	July 23	2.18	352
January 16	3.60	1,890	April 19	3.90	1,780	July 24	3.70	2,100
January 17	5.00	3,540	April 20	3.80	1,570	July 25	2.95	946
January 18	4.65	2,850	April 22	3.80	1,550	July 26	2.60	657
January 19	4.30	3,040	April 23	3.70	1,440	July 27	2.50	568
January 21	4.10	2,830	April 24	3.60	1,380	July 29	2.35	452
January 22	3.80	2,320	April 25	3.50	1,220	July 30	2.22	385
January 23	3.70	1,990	April 26	3.40	1,130	July 31	2.28	382
January 24	3.50	1,880	April 27	3.30	1,060	August 1	2.52	574
January 25	3.40	1,690	April 29	3.30	1,010	August 2	3.08	875
January 26	3.35	1,620	April 30	3.30	1,080	August 3	3.35	1,460
January 28	3.30	1,540	May 1	3.40	1,120	August 5	3.02	984
January 29	3.30	1,530	May 2	3.40	1,150	August 6	2.80	778
January 31	5.50	5,870	May 3	3.30	1,070	August 7	2.58	601
February 1	5.65	6,410	May 4	3.30	1,000	August 8	2.45	517
February 2	5.05	3,830	May 7	3.10	881	August 9	2.38	456
February 4	4.25	2,960	May 8	3.05	828	August 10	2.32	398
February 5	4.10	2,700	May 9	3.00	794	August 11	2.22	372
February 6	4.10	2,630	May 10	3.00	754	August 13	2.20	368
February 7	4.17	2,810	May 11	3.00	740	August 14	2.18	354
February 8	4.20	2,790	May 13	2.90	727	August 15	2.20	341
February 9	4.15	2,880	May 14	2.90	698	August 16	2.25	376
February 11	3.90	2,390	May 15	2.90	682	August 17	2.50	610
February 12	3.80	2,150	May 16	2.85	680	August 19	2.42	538
February 13	3.75	2,020	May 17	2.85	676	August 20	3.00	1,080
February 14	3.65	1,820	May 18	2.80	656	August 21	2.85	778
February 15	3.60	1,720	May 20	2.80	623	August 22	3.15	1,140
February 16	3.50	1,680	May 21	2.75	616	August 23	3.45	1,360
February 18	3.60	1,750	May 22	2.70	581	August 24	3.35	1,200
February 19	4.47	2,200	May 23	2.70	578	August 26	3.00	901
February 20	3.80	2,030	May 24	2.75	586	August 27	3.02	907
February 21	3.70	1,890	May 25	2.75	597	August 28	3.32	1,010
February 23	3.70	1,890	May 27	2.80	649	August 29	3.80	1,340
February 25	4.40	3,050	May 28	2.80	627	August 30	4.42	2,800
February 26	4.20	2,610	May 29	2.85	672	August 31	5.58	5,740
February 27	4.10	2,320	May 30	2.90	704	September 2	4.15	2,070
February 28	4.00	2,200	May 31	2.95	728	September 3	3.85	1,630
March 1	4.00	2,120	June 1	2.95	715	September 4	5.10	3,600
March 2	3.90	2,090	June 3	2.80	639	September 5	4.32	2,570
March 4	4.36	2,010	June 4	2.70	560	September 6	3.90	1,630
March 5	4.75	3,950	June 5	2.65	548	September 7	3.75	1,590
March 6	8.95	15,900	June 6	2.65	527	September 9	3.62	1,390
March 7	6.30	7,250	June 7	2.65	572	September 10	3.48	1,210
March 8	5.40	4,460	June 8	2.70	585	September 17	3.10	823
March 9	4.80	3,670	June 10	2.68	604	September 18	3.10	673
March 11	4.40	2,790	June 11	2.60	588	September 19	3.00	695
March 12	4.20	2,390	June 12	2.58	552	September 20	3.00	650
March 13	4.10	2,260	June 13	2.52	528	September 21	3.00	577
March 14	4.10	2,170	June 14	2.50	499	September 23	2.90	547
March 15	4.10	2,010	June 15	2.50	491	September 24	2.90	516
March 16	4.00	1,890	June 17	2.45	480	September 25	2.90	519
March 18	3.90	1,720	June 18	2.45	484	September 26	2.90	514
March 19	4.00	1,910	June 19	2.40	460	September 27	2.90	457
March 20	4.10	2,140	June 20	2.40	465	September 28	2.80	445
March 21	4.35	2,590	June 21	2.50	551	September 29	2.80	416
March 22	5.30	5,180	June 22	2.50	551	October 1	2.80	420
March 23	7.70	10,300	June 24	2.42	462	October 2	2.80	411
March 25	5.40	5,860	June 27	2.30	388	October 3	2.80	407
March 26	5.05	4,700	June 28	2.25	374	October 4	2.80	426
March 27	4.85	3,790	June 29	2.20	350	October 5	3.80	416
March 28	4.50	3,140	July 1	2.15	336	October 7	2.80	420
March 29	4.50	2,780	July 2	2.10	334	October 8	2.85	477
March 30	4.30	2,360	July 3	2.10	330	October 9	2.80	382
April 1	4.10	1,970	July 5	2.15	306	October 10	2.75	421
April 2	4.20	2,410	July 6	2.22	370	October 11	2.75	436
April 3	4.20	2,220	July 8	2.12	368	October 12	2.75	431
April 4	4.50	2,950	July 9	2.10	290	October 14	2.70	387
April 5	4.50	2,860	July 10	2.10	319	October 15	2.70	388
April 6	4.40	2,410	July 11	2.10	318	October 16	2.70	385
April 8	4.30	2,200	July 12	2.10	291	October 17	2.68	356

Discharge measurements of Salt River at Roosevelt, Ariz., in 1907—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
October 18	4.45	2,570	November 2	3.40	1,170	November 21	3.45	1,050
October 18	5.50	4,830	November 4	3.40	1,160	November 22	3.42	1,020
October 19	4.00	1,890	November 5	3.25	923	November 23	3.35	879
October 21	3.50	1,380	November 6	3.20	806	November 26	3.22	715
October 22	3.30	1,190	November 7	3.20	744	November 27	3.20	695
October 23	3.30	1,010	November 9	3.20	682	November 29	3.20	692
October 24	4.70	3,510	November 11	3.25	727	November 30	3.20	690
October 24	5.30	4,520	November 12	3.28	759	December 2	3.15	637
October 25	6.50	8,740	November 13	3.35	943	December 4	3.10	588
October 26	4.95	3,450	November 14	3.35	849	December 5	3.10	594
October 28	4.00	1,780	November 15	3.35	845	December 6	3.05	535
October 29	3.80	1,570	November 16	3.30	790	December 7	3.00	536
October 30	3.60	1,280	November 18	3.45	1,050	December 9	3.00	521
October 31	3.40	1,130	November 19	3.40	994			
November 1	3.35	1,150	November 20	3.50	1,200			

Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.75	4.00	4.10	3.40	2.92	2.15	2.52	4.86	2.80	3.32	3.20
2	.....	5.00	3.90	4.20	3.40	2.88	2.10	3.07	4.15	2.80	3.40	3.15
3	3.20	4.60	3.85	4.20	3.30	2.73	2.10	3.35	3.85	2.80	3.50	3.15
4	.....	4.25	3.85	4.60	3.25	2.70	2.10	4.80	5.10	2.80	3.40	3.10
5	.....	4.10	5.10	4.50	3.18	2.70	2.15	3.02	4.32	2.80	3.30	3.10
6	.....	4.12	8.40	4.40	3.10	2.60	2.22	2.80	3.90	2.80	3.25	3.02
7	4.90	4.22	6.15	4.35	3.10	2.65	2.18	2.58	3.75	2.80	3.20	3.00
8	5.00	4.20	5.30	4.30	3.05	2.70	2.13	2.45	3.68	2.85	3.18	3.00
9	5.80	4.12	4.70	4.30	3.00	2.69	2.10	2.38	3.62	2.80	3.15	3.00
10	6.70	4.00	4.50	4.40	3.00	2.67	2.10	2.32	3.47	2.75	3.20	.....
11	5.90	3.90	4.35	4.50	3.00	2.60	2.10	2.28	3.30	2.75	3.25	.....
12	5.02	3.80	4.25	4.50	2.95	2.58	2.10	2.22	3.20	2.75	3.34	.....
13	4.95	3.72	4.10	4.50	2.90	2.53	2.05	2.20	3.20	2.75	3.38	.....
14	4.15	3.62	4.10	4.45	2.90	2.50	2.00	2.18	3.15	2.70	3.35	.....
15	3.75	3.55	4.05	4.40	2.90	2.50	2.00	2.22	3.18	2.70	3.35	.....
16	3.55	3.50	4.00	4.30	2.85	2.48	2.05	2.25	3.20	2.70	3.30	.....
17	4.90	3.55	3.95	4.15	2.85	2.45	2.05	2.50	3.10	2.68	3.30	.....
18	4.45	3.60	3.90	4.00	2.80	2.45	2.00	2.95	3.10	5.10	3.40	.....
19	4.30	3.90	4.00	3.90	2.80	2.40	2.00	2.42	3.00	4.00	3.40	.....
20	4.20	3.83	4.15	3.80	2.80	2.40	2.00	3.00	3.00	3.35	3.50	.....
21	4.05	3.70	4.38	3.78	2.75	2.50	2.12	2.85	3.00	3.40	3.48	.....
22	3.80	3.70	5.55	3.75	2.70	2.50	2.22	3.15	2.95	3.25	3.38	.....
23	3.70	3.70	7.70	3.70	2.70	2.47	2.18	3.45	2.90	3.30	3.32	.....
24	3.50	4.40	6.00	3.60	2.75	2.42	3.70	3.35	2.90	5.00	3.30	.....
25	3.40	4.40	5.35	3.50	2.75	2.40	2.95	3.25	2.90	6.60	3.30	.....
26	3.35	4.20	5.15	3.40	2.85	2.30	2.60	3.00	2.90	4.70	3.22	.....
27	3.30	4.10	4.85	3.30	2.80	2.30	2.50	3.02	2.90	4.38	3.20	.....
28	3.30	4.00	4.55	3.30	2.80	2.25	2.42	3.32	2.80	3.95	3.20	.....
29	3.30	.....	4.45	3.25	2.85	2.20	2.35	3.80	2.80	3.75	3.20	.....
30	3.55	.....	4.30	3.30	2.90	2.17	2.22	6.65	2.80	3.55	3.20	.....
31	6.35	.....	4.02	.....	2.95	.....	2.27	5.58	.....	3.38	.....	.....

Daily discharge, in second-feet, of Salt River at Roosevelt, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6,600	2,120	1,970	1,120	715	336	574	3,350	420	1,130	670
2	.....	3,670	2,040	2,410	1,150	674	334	875	2,070	411	1,170	637
3	892	3,250	1,860	2,220	1,070	639	330	1,460	1,630	407	1,260	630
4	.....	2,960	1,860	3,010	1,000	560	320	4,300	3,600	426	1,160	587
5	.....	2,700	4,740	2,860	940	548	306	984	2,579	416	936	594
6	.....	2,630	14,200	2,410	881	527	370	778	1,630	420	808	535
7	5,120	2,970	7,010	2,300	881	572	368	601	1,590	430	744	526
8	4,830	2,790	4,390	2,200	828	585	368	517	1,490	477	676	521
9	6,520	2,800	3,410	2,210	794	595	290	456	1,390	382	670	520
10	9,030	2,640	2,940	2,440	754	604	319	398	1,210	422	700	.....
11	7,550	2,400	2,750	2,510	740	588	318	390	1,020	436	726	.....
12	4,930	2,150	2,430	2,520	734	552	291	372	930	431	830	.....
13	4,420	1,980	2,260	2,550	627	528	292	368	930	430	942	.....
14	2,180	1,820	2,170	2,460	698	499	294	354	880	387	850	.....
15	2,100	1,740	2,010	2,370	682	491	294	341	900	388	845	.....
16	1,890	1,680	1,890	2,200	680	485	299	376	930	385	790	.....
17	3,280	1,720	1,830	1,940	676	480	285	610	823	356	800	.....
18	2,440	1,750	1,790	1,870	656	484	277	910	673	3,350	1,040	.....
19	3,040	2,200	1,910	1,780	640	460	265	538	695	1,890	994	.....
20	2,930	2,030	2,200	1,570	623	465	262	1,080	650	1,380	1,200	.....
21	2,830	1,890	2,620	1,550	616	552	320	778	576	1,440	1,050	.....
22	2,320	1,890	5,580	1,490	581	551	367	1,140	562	1,190	1,020	.....
23	1,990	1,890	10,300	1,440	578	520	352	1,360	547	1,010	879	.....
24	1,880	3,050	6,300	1,380	586	462	2,100	1,200	515	4,030	860	.....
25	1,690	3,050	5,720	1,220	597	440	946	1,080	519	8,740	840	.....
26	1,620	2,610	4,700	1,130	670	400	657	901	513	3,020	715	.....
27	1,540	2,320	3,790	1,060	649	388	568	907	457	2,340	695	.....
28	1,540	2,200	3,140	1,010	627	374	510	1,010	445	1,720	692	.....
29	1,530	.....	2,780	970	672	350	452	1,340	416	1,500	690	.....
30	1,910	.....	2,360	1,080	704	340	385	8,560	416	1,220	680	.....
31	8,730	.....	1,950	.....	728	.....	382	5,740	.....	1,130	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Salt River at Roosevelt, Ariz., for 1907.

[Drainage area, 5,760 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January (26 days)	[a] 11,600	892	3,410	0.592	0.57	176,000
February	[a] 6,950	1,680	2,550	.443	.46	142,000
March	[a] 17,000	1,790	3,710	.644	.74	228,000
April	[a] 3,410	970	1,940	.337	.38	115,000
May	1,150	578	748	.130	.15	46,000
June	715	340	514	.089	.10	30,600
July	[a] 2,550	262	428	.074	.09	26,300
August	[a] 11,100	341	1,300	.226	.26	79,900
September	3,600	416	1,130	.196	.22	67,200
October	[a] 9,700	356	1,320	.229	.26	81,200
November	1,260	670	880	.153	.17	52,400
December 1–9	670	520	580	.101	.03	10,400
The period	.....	.....	.....	.....	.....	1,060,000

[a] Maximum discharge recorded for the month. These occurred on January 31, February 1, March 6, April 4, May 24, August 30, and October 25.

SALT RIVER AT McDOWELL, ARIZ.

This station, which was established April 20, 1897, to determine the amount of water available for irrigation, is located one-third mile above the junction of Salt and Verde rivers, 30 miles northeast of

Phoenix, 15 miles northeast of Mesa, and 1¾ miles above the Arizona canal diversion dam.

The bed of the river at this point is sandy and shifting, and frequent measurements are required to properly determine the daily discharge.

The results published herewith were furnished by the United States Reclamation Service.

Discharge measurements of Salt River at McDowell, Ariz., in 1907 and 1908.

[By W. Richins.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
January 2	6.50	5,350	June 27	2.55	450	December 10	3.10	600
January 4	5.80	3,210	June 29	2.45	377	December 13	3.10	597
January 8	6.60	5,630	July 2	2.30	341	December 17	3.05	569
January 10	7.75	9,690	July 6	2.20	299	December 20	3.00	476
January 12	6.85	6,200	July 9	2.25	348	December 24	3.00	448
January 15	5.55	2,850	July 11	2.20	308	December 27	3.00	443
January 18	6.00	3,530	July 13	2.20	314	December 31	3.00	415
January 22	5.75	2,650	July 16	2.15	305			
January 25	5.50	2,100	July 18	2.15	309	1908.		
January 29	5.30	1,760	July 20	2.10	304	January 3	3.00	426
January 31	6.58	5,030	July 23	2.30	408	January 7	3.05	493
February 2	6.85	5,520	July 25	3.60	1,250	January 10	3.00	428
February 6	6.00	3,150	July 27	2.95	685	January 14	2.95	400
February 8	6.10	3,310	July 30	2.65	492	January 17	3.00	399
February 12	5.80	2,820	August 1	2.55	470	January 21	2.95	405
February 15	5.50	2,200	August 3	3.50	1,120	January 24	2.95	392
February 19	5.60	2,450	August 5	3.40	974	January 28	2.95	383
February 22	5.60	2,660	August 8	3.00	635	January 31	2.95	394
February 26	6.00	3,330	August 10	2.80	514	February 4	12.00	29,800
February 28	5.65	2,870	August 13	2.60	446	February 6	5.92	6,010
March 6	10.25	18,300	August 15	2.45	393	February 8	5.50	2,620
March 7	8.05	9,270	August 17	2.50	396	February 11	5.10	2,030
March 9	6.55	4,470	August 20	2.80	551	February 13	5.15	2,110
March 12	6.00	3,340	August 22	3.20	806	February 15	5.10	1,730
March 15	5.90	2,740	August 24	3.90	1,330	February 18	5.50	2,360
March 19	5.70	3,300	August 27	3.40	883	February 20	5.55	2,400
March 22	6.40	3,950	August 29	4.15	1,700	February 22	5.15	1,850
March 23	8.20	10,500	August 31	7.30	7,390	February 25	5.80	3,880
March 25	7.15	6,710	September 3	5.05	2,030	February 27	5.40	2,640
March 27	6.30	4,470	September 4	5.05	2,090	March 3	5.40	2,730
March 29	6.00	3,570	September 6	5.00	2,020	March 5	5.35	2,600
April 2	5.45	2,880	September 10	4.20	1,390	March 7	6.85	8,980
April 5	5.80	3,830	September 12	3.75	1,120	March 9	5.65	4,440
April 9	5.50	3,170	September 14	3.50	831	March 11	5.35	3,340
April 11	5.50	3,270	September 17	3.45	819	March 13	5.10	2,570
April 13	5.50	3,150	September 19	3.20	671	March 17	5.30	2,740
April 15	5.40	3,080	September 21	3.05	638	March 20	5.75	3,870
April 17	5.15	2,800	September 24	2.85	529	March 24	5.50	3,180
April 19	4.95	2,230	September 26	2.75	493	March 27	5.25	2,580
April 23	4.60	1,760	October 1	2.60	409	March 31	5.00	2,130
April 26	4.35	1,370	October 3	2.55	395	April 3	4.60	1,640
April 30	4.10	1,220	October 5	2.55	397	April 7	4.70	1,880
May 2	4.10	1,280	October 9	2.65	472	April 10	4.70	2,090
May 4	4.00	1,240	October 11	2.60	456	April 14	4.40	1,660
May 7	3.70	1,000	October 15	2.50	347	April 17	4.40	1,570
May 9	3.60	960	October 17	2.50	360	April 21	4.20	1,360
May 11	3.55	922	October 19	5.20	2,870	April 24	4.35	1,580
May 13	3.45	840	October 22	3.55	1,070	April 28	4.30	1,500
May 15	3.40	783	October 24	3.50	1,040	May 1	4.10	1,230
May 17	3.35	820	October 25	6.75	7,180	May 5	4.10	1,190
May 21	3.25	742	October 29	4.65	1,620	May 8	4.15	1,260
May 23	3.15	653	October 31	4.20	1,200	May 12	3.95	1,080
May 25	3.20	698	November 2	4.05	1,150	May 15	3.80	948
May 28	3.20	703	November 5	4.00	1,150	May 19	3.60	845
May 31	3.30	858	November 7	3.25	1,020	May 22	3.50	790
June 4	3.15	716	November 9	3.70	955	May 26	3.50	807
June 6	3.05	653	November 12	3.70	983	May 29	3.30	655
June 8	3.00	635	November 15	3.75	1,020	June 3	3.15	621
June 11	3.00	628	November 19	3.70	1,010	June 5	3.10	579
June 13	2.90	534	November 21	3.75	1,080	June 9	3.05	523
June 15	2.85	523	November 23	3.60	949	June 12	2.90	461
June 18	2.75	494	November 26	3.40	830	June 15	2.85	427
June 20	2.70	491	November 29	3.30	749	June 17	2.85	434
June 22	2.80	524	December 3	3.20	676	June 19	2.85	440
June 25	2.70	503	December 6	3.20	661	June 23	2.70	387

Discharge measurements of Salt River at McDowell, Ariz., in 1907 and 1908—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1908.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
June 25	2.65	345	September 4	6.00	2,860	November 10	3.95	600
June 30	2.55	271	September 8	4.90	1,350	November 13	3.45	356
July 3	2.50	268	September 11	4.70	1,060	November 17	4.85	1,300
July 7	2.40	230	September 15	4.30	828	November 20	3.60	455
July 10	2.35	214	September 18	4.15	758	November 24	3.40	382
July 14	2.85	489	September 22	3.95	578	November 27	3.40	344
July 17	3.50	868	September 25	3.85	498	December 1	3.50	372
July 21	3.80	1,060	September 29	3.90	565	December 4	4.15	812
July 22	3.40	796	October 2	3.75	473	December 8	3.70	490
July 24	3.25	700	October 6	3.65	384	December 11	3.55	396
July 28	5.50	2,860	October 9	3.65	387	December 15	3.65	502
July 31	4.00	956	October 13	3.55	355	December 16	12.40	[b] 1,300
August 4	3.85	936	October 16	3.50	320	December 17	13.00	35,000
August 7	4.20	1,100	October 20	3.75	501	December 19	7.15	9,710
August 14	4.20	1,090	October 23	3.65	409	December 22	6.05	4,250
August 17	4.65	1,400	October 27	3.55	376	December 24	6.00	4,340
August 21	6.00	3,760	October 30	3.50	370	December 29	3.45	450
August 25	5.75	2,480	November 4	3.45	342	December 31	3.55	554
August 28	6.00	3,010	November 6	3.45	336			
September 1	6.05	3,120	November 7	2.95	[a] 125			

[a] Shut gate at Roosevelt caused drop in river. [b] Gaging was influenced by high water in Verde.

Daily gage height, in feet, of Salt River at McDowell, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.05	7.62	5.65	5.52	4.05	3.35	2.35	2.60	5.85	2.58	4.10	3.28
2	6.45	6.80	5.65	5.52	4.10	3.30	2.30	3.15	5.45	2.55	4.05	3.25
3	6.05	6.50	5.70	5.50	4.08	3.22	2.30	3.35	5.15	2.55	4.10	3.20
4	5.75	6.30	5.75	5.62	4.00	3.15	2.30	4.00	5.52	2.55	4.08	3.20
5	5.50	6.08	5.82	5.78	3.90	3.08	2.25	3.65	5.57	2.55	3.98	3.20
6	5.60	6.00	10.35	5.52	3.78	3.05	2.20	3.38	4.92	2.55	3.88	3.20
7	6.30	6.05	7.95	5.50	3.70	3.02	2.20	3.15	4.77	2.55	3.82	3.15
8	6.60	6.15	7.12	5.50	3.65	3.00	2.20	2.98	4.60	2.60	3.75	3.15
9	6.55	6.15	6.55	5.50	3.60	3.05	2.22	2.85	4.40	2.65	3.70	3.15
10	7.80	5.90	6.45	5.52	3.60	3.05	2.20	2.78	4.15	2.62	3.70	3.10
11	7.40	5.88	6.30	5.50	3.55	3.00	2.22	2.69	3.90	2.60	3.70	3.10
12	6.78	5.80	5.98	5.48	3.50	2.98	2.20	2.60	3.72	2.60	3.72	3.10
13	6.15	5.68	6.05	5.50	3.45	2.90	2.20	2.58	3.58	2.58	3.82	3.10
14	5.82	5.58	6.98	5.45	3.40	2.88	2.18	2.52	3.50	2.55	3.75	3.10
15	5.55	5.50	5.90	5.40	3.40	2.85	2.15	2.45	3.50	2.50	3.75	3.08
16	5.50	5.40	5.85	5.25	3.40	2.82	2.12	2.50	3.50	2.50	3.70	3.05
17	5.75	5.40	5.72	5.18	3.35	2.80	2.12	2.50	3.40	2.50	3.68	3.05
18	5.98	5.42	5.70	5.05	3.35	2.75	2.12	2.70	3.27	3.85	3.65	3.05
19	5.90	5.55	5.80	4.95	3.30	2.70	2.10	2.72	3.18	5.00	3.68	3.05
20	6.00	5.72	6.00	4.80	3.25	2.68	2.10	3.25	3.12	4.25	3.78	3.00
21	5.90	5.68	6.25	4.74	3.22	2.68	2.10	3.42	3.02	3.95	3.75	3.00
22	5.72	5.62	6.40	4.68	3.20	2.80	2.08	3.15	2.95	3.50	3.70	3.00
23	5.60	5.55	8.60	4.60	3.15	2.75	2.32	3.80	2.90	3.50	3.60	3.00
24	5.58	5.92	7.80	4.48	3.18	2.70	2.65	3.82	2.85	4.30	3.52	3.00
25	5.50	6.10	7.15	4.40	3.20	2.68	3.58	4.01	2.87	6.55	3.48	2.95
26	5.32	5.98	6.55	4.32	3.20	2.58	3.15	3.95	2.75	5.75	3.40	2.95
27	5.30	5.80	6.30	4.22	3.20	2.52	2.92	3.48	2.70	5.20	3.35	3.00
28	5.30	5.62	6.12	4.14	3.20	2.48	2.86	3.72	2.65	4.98	3.30	3.00
29	5.30	.....	6.02	4.05	3.22	2.42	2.80	4.58	2.62	4.60	3.30	3.00
30	5.30	.....	5.82	4.05	3.28	2.38	2.62	5.58	2.60	4.40	3.30	3.00
31	6.55	.....	5.65	.....	3.30	.....	2.80	7.15	.....	4.20	.....	3.00

Daily gage height, in feet, of Salt River at McDowell, Ariz., for 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.00	2.90	5.35	4.88	4.10	3.20	2.52	4.38	5.98	3.80	3.45	3.50
2	3.00	2.90	5.38	4.70	4.10	3.18	2.50	4.03	5.68	3.75	3.45	3.45
3	3.00	2.98	5.35	4.60	4.10	3.15	2.50	4.05	5.85	3.70	3.45	3.55
4	3.00	12.22	5.22	4.60	4.10	3.15	2.45	3.88	6.00	3.70	3.45	4.18
5	3.00	8.60	6.12	4.70	4.10	3.10	2.40	4.12	5.78	3.65	3.45	4.02
6	3.02	5.85	8.95	4.80	4.05	3.10	2.40	4.20	5.40	3.65	3.32	3.85
7	3.05	5.70	6.62	4.75	4.02	3.10	2.38	4.18	5.10	3.65	2.95	3.75
8	3.00	5.52	6.02	4.75	4.10	3.08	2.35	4.38	4.95	3.62	2.95	3.70
9	3.00	5.45	5.68	4.72	4.17	3.05	2.35	4.70	4.75	3.65	3.50	3.65
10	3.00	5.32	5.48	4.72	4.10	3.02	2.48	4.70	4.62	3.60	3.98	3.60
11	3.00	5.10	5.30	4.62	4.00	2.95	2.68	4.18	4.70	3.60	3.58	3.55
12	3.00	5.02	5.15	4.55	3.92	2.90	2.55	4.00	4.58	3.55	3.45	3.50
13	3.00	5.18	5.12	4.42	3.88	2.90	2.70	4.08	4.45	3.55	3.45	3.50
14	2.95	5.22	5.00	4.42	3.85	2.90	2.85	4.12	4.40	3.50	3.45	3.50
15	2.95	5.10	5.05	4.40	3.78	2.88	2.98	3.85	4.30	3.50	3.15	3.95
16	2.98	5.30	5.12	4.40	3.72	2.85	3.30	5.08	4.22	3.50	2.80	12.25
17	3.00	5.48	5.32	4.40	3.65	2.85	3.90	4.68	4.20	3.50	4.58	13.65
18	2.95	5.60	5.55	4.35	3.62	2.85	3.98	6.05	4.15	3.45	3.50	9.45
19	2.95	5.95	5.60	4.30	3.58	2.85	4.60	6.35	4.10	3.55	3.45	7.18
20	2.95	5.65	5.75	4.25	3.52	2.80	4.45	6.25	4.05	3.75	3.52	6.40
21	2.95	5.15	5.72	4.20	3.50	2.80	3.70	6.05	4.00	3.70	3.15	6.15
22	2.95	5.12	5.65	4.25	3.50	2.72	3.48	6.60	3.92	3.68	3.70	6.08
23	2.95	5.85	5.55	4.32	3.55	2.70	3.35	6.30	3.90	3.62	3.40	6.00
24	2.95	6.30	5.50	4.35	3.55	2.70	3.22	5.88	3.90	3.60	3.40	6.02
25	2.95	5.82	5.30	4.35	3.50	2.65	3.68	5.70	3.85	3.60	3.40	6.02
26	2.95	5.60	5.20	4.35	3.48	2.65	4.20	5.95	3.85	3.60	3.40	5.92
27	2.95	5.40	5.35	4.35	3.42	2.60	3.98	5.98	3.90	3.55	3.40	5.75
28	2.95	5.35	5.45	4.30	3.32	2.60	5.88	5.95	3.95	3.50	3.50	4.00
29	2.95	5.35	5.30	4.22	3.30	2.58	4.92	5.92	3.88	3.50	3.55	3.45
30	2.95	.....	5.18	4.18	3.25	2.55	4.32	6.10	3.85	3.50	3.55	3.25
31	2.95	.....	5.00	.....	3.20	.....	3.95	6.20	.....	3.50	.....	3.42

Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6,750	8,860	2,760	2,900	1,250	860	350	500	3,150	400	1,150	730
2	5,200	5,350	2,760	3,070	1,280	820	341	830	2,450	395	1,120	710
3	3,940	4,440	2,840	2,890	1,270	780	340	1,040	2,130	395	1,150	676
4	3,130	3,900	2,900	3,180	1,240	716	340	1,420	2,750	395	1,140	670
5	2,630	3,320	3,000	3,740	1,160	690	320	1,140	2,870	397	1,090	670
6	2,850	3,150	18,600	2,970	1,080	653	300	960	1,950	397	1,020	661
7	4,600	3,230	8,880	3,070	1,000	640	310	740	1,880	400	1,010	650
8	5,630	3,260	6,170	3,140	980	635	310	630	1,670	440	970	640
9	5,540	3,490	4,470	3,170	960	635	340	540	1,530	472	955	630
10	9,870	2,910	4,260	3,340	960	635	320	510	1,360	460	960	600
11	8,290	2,900	3,940	3,270	922	628	320	470	1,210	456	970	600
12	6,000	2,820	3,300	3,120	890	620	320	440	1,100	440	990	600
13	4,130	2,540	3,380	3,150	840	534	314	430	910	410	1,060	600
14	3,340	2,340	3,010	3,120	800	630	310	410	831	380	1,020	600
15	2,850	2,200	2,740	3,080	783	523	305	393	830	347	1,020	580
16	2,690	2,110	2,570	2,880	800	510	305	396	820	350	990	570
17	3,190	2,140	2,370	2,800	820	500	305	396	780	360	980	569
18	3,500	2,200	2,330	2,470	820	494	305	440	740	1,350	960	550
19	3,160	2,400	2,430	2,230	785	490	304	500	670	2,620	1,000	530
20	3,400	2,640	2,840	2,090	760	490	304	760	660	1,650	1,090	476
21	3,020	2,580	3,460	1,980	750	500	304	880	640	1,400	1,080	470
22	2,620	2,540	3,950	1,880	690	524	308	770	590	1,040	1,030	460
23	2,340	2,430	11,900	1,760	653	510	410	1,220	566	1,040	949	450
24	2,290	3,080	8,950	1,590	670	505	630	1,260	530	1,580	900	448
25	2,100	3,780	6,710	1,470	698	500	1,230	1,350	530	6,700	880	440
26	1,880	3,320	5,000	1,360	700	470	860	1,270	493	3,900	830	440
27	1,820	3,040	4,470	1,290	700	450	680	930	480	2,330	780	443
28	1,790	2,820	3,920	1,250	703	420	620	1,270	450	1,950	770	440
29	1,760	.....	3,600	1,200	750	375	580	2,230	430	1,600	760	430
30	1,900	.....	3,380	1,200	800	360	490	3,500	410	1,390	749	420
31	5,030	.....	3,120	.....	858	.....	570	7,100	.....	1,200	.....	415

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	426	370	2,640	1,960	1,230	630	270	1,240	3,000	500	350	372
2	426	370	2,700	1,750	1,220	625	270	1,020	2,450	473	342	360
3	426	400	2,700	1,700	1,210	621	268	1,050	2,650	470	340	420
4	426	30,900	2,500	1,680	1,190	610	250	940	2,860	460	340	812
5	426	16,900	3,950	1,830	1,190	579	240	1,100	2,500	400	336	700
6	460	6,000	23,500	1,940	1,170	570	240	1,130	1,920	384	300	590
7	493	3,800	7,500	1,930	1,160	560	230	1,100	1,570	385	125	540
8	428	2,700	5,600	1,980	1,260	540	220	1,230	1,410	380	125	490
9	428	2,490	4,450	2,050	1,270	523	214	1,470	1,180	387	490	470
10	428	2,290	3,850	2,100	1,210	500	260	1,470	1,030	370	600	430
11	428	2,030	3,300	1,960	1,130	480	360	1,080	1,060	370	460	396
12	420	1,970	2,840	1,860	1,080	461	300	950	980	355	360	390
13	410	2,130	2,570	1,700	1,030	450	370	1,010	900	350	356	410
14	400	2,010	2,410	1,670	1,000	440	460	1,030	880	330	350	410
15	400	1,730	2,470	1,630	948	427	530	840	828	330	210	690
16	400	1,930	2,510	1,600	910	430	730	1,780	790	320	80	11,300
17	400	2,240	2,790	1,570	878	434	1,100	1,400	780	320	1,070	35,000
18	400	2,480	3,190	1,520	864	436	1,160	3,270	758	300	400	18,800
19	400	3,200	3,440	1,470	845	440	1,600	4,100	740	390	370	9,710
20	400	2,540	3,870	1,420	820	420	1,480	4,120	660	501	420	6,000
21	405	2,150	3,960	1,360	700	410	1,000	3,820	620	460	250	4,700
22	400	1,600	3,680	1,440	790	390	800	5,440	560	440	530	4,250
23	400	3,400	3,200	1,520	800	387	760	3,920	540	410	390	4,200
24	392	4,800	3,180	1,580	800	370	680	2,600	530	400	382	4,340
25	390	4,000	2,800	1,580	800	345	1,000	2,410	498	400	370	4,100
26	390	3,000	2,590	1,580	800	330	1,360	2,880	500	390	360	3,700
27	385	2,640	2,740	1,570	740	310	1,260	2,930	540	376	344	3,100
28	383	2,640	2,860	1,500	690	300	3,500	2,910	590	370	390	840
29	385	2,640	2,580	1,410	665	385	2,500	2,900	560	370	410	450
30	390	.....	2,350	1,320	640	271	1,300	3,280	530	370	400	360
31	394	.....	2,130	.....	630	.....	930	3,470	.....	370	.....	470

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Salt River at McDowell, Ariz., for 1907 and 1908.

[Drainage area, 6,260 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1907.						
January	[a] 10,200	1,760	3,780	0.604	0.70	232,000
February	[a] 9,980	2,110	3,210	.513	.53	178,000
March	[a] 19,500	2,330	4,640	.741	.85	285,000
April	3,740	1,200	2,490	.398	.44	148,000
May	1,280	653	883	.141	.16	54,300
June	860	360	570	.091	.10	33,900
July	1,230	300	421	.067	.08	25,900
August	[a] 9,200	393	1,120	.179	.21	68,900
September	[a] 3,500	410	1,180	.188	.21	70,200
October	[a] 9,400	347	1,180	.188	.22	72,600
November	1,150	749	979	.156	.17	58,300
December	730	415	554	.088	.10	34,100
The year	19,500	300	1,750	.280	3.79	1,260,000

[a] See footnote at end of table, next page.

Monthly discharge of Salt River at McDowell, Ariz., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1908.						
January	493	383	411	0.066	0.08	25,300
February	[a] 47,300	370	3,980	.636	.69	229,000
March	[a] 24,200	2,130	3,900	.623	.72	240,000
April	2,100	1,320	1,670	.267	.30	99,400
May	[a] 1,300	630	957	.153	.18	58,800
June	630	271	456	.073	.08	27,100
July	[a] 7,700	214	827	.132	.15	50,800
August	[a] 5,720	840	2,190	.350	.40	135,000
September	[a] 3,150	498	1,150	.184	.21	68,400
October	501	300	391	.062	.07	24,000
November	[a] 1,300	80	375	.060	.07	22,300
December	[a] 40,000	360	3,840	.613	.71	236,000
The year	47,300	80	1,680	.268	3.66	1,220,000

[a] Maximum discharge recorded for the month. These occurred in 1907 on January 10, February 1, March 6, August 31, September 1, and October 25, and in 1908 on February 4, March 6, May 8, July 28, August 22, September 1, November 17, and December 17.

VERDE RIVER AT McDOWELL, ARIZ.

This station, which was established April 20, 1897, to determine the quantity of water in the Verde available for irrigation, is located 30 miles northeast of Phoenix, 15 miles northeast of Mesa, 2½ miles above the Arizona canal diversion dam, and three-fourths mile above the mouth of the river.

As the bed of the stream at this point is sandy and shifting, frequent measurements are required to properly determine the daily discharge.

The results published herewith were furnished by the United States Reclamation Service.

Discharge measurements of Verde River at McDowell, Ariz., in 1907 and 1908.

[By W. Richins.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
January 2	5.70	2,610	February 28	2.90	1,610	April 19	2.50	403
January 4	4.30	1,650	March 6	14.6	33,100	April 23	2.45	327
January 8	4.20	1,690	March 7	9.00	11,200	April 26	2.40	293
January 10	5.95	3,710	March 9	5.50	5,140	April 30	2.40	331
January 12	7.75	6,730	March 12	4.25	2,680	May 2	2.35	292
January 15	4.40	1,940	March 15	3.40	1,520	May 4	2.40	321
January 18	3.50	1,130	March 19	2.95	896	May 7	2.30	257
January 22	3.40	1,210	March 22	3.35	1,260	May 9	2.30	271
January 25	3.35	1,180	March 23	6.80	7,150	May 11	2.30	245
January 29	3.25	1,230	March 25	5.44	2,510	May 13	2.25	224
January 31	8.9	12,500	March 27	3.70	1,600	May 15	2.25	232
February 2	6.75	5,000	March 29	3.60	1,510	May 17	2.30	266
February 6	5.45	3,360	April 2	3.40	1,060	May 21	2.30	247
February 8	5.00	3,380	April 5	4.25	2,180	May 23	2.25	226
February 12	3.10	1,530	April 9	3.30	1,060	May 25	2.20	208
February 15	2.70	1,100	April 11	3.05	788	May 28	2.20	227
February 19	4.30	2,830	April 13	2.90	639	May 31	2.35	274
February 22	2.75	1,340	April 15	2.75	551	June 4	2.30	248
February 26	3.70	2,310	April 17	2.60	462	June 6	2.25	218

Discharge measurements of Verde River at McDowell, Ariz., in 1907 and 1908—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
June 8	2.20	213	November 15	2.90	366	June 3	3.35	139
June 11	2.20	212	November 19	3.00	380	June 5	3.40	179
June 13	2.25	226	November 21	3.05	393	June 9	3.35	163
June 15	2.20	197	November 23	3.00	370	June 12	3.35	156
June 18	2.20	198	November 26	2.95	330	June 15	3.30	151
June 20	2.20	211	November 29	2.95	319	June 17	3.25	136
June 22	2.20	191	December 3	2.95	315	June 19	3.30	140
June 25	2.15	179	December 6	2.95	350	June 23	3.25	131
June 27	2.15	186	December 10	2.95	322	June 26	3.25	123
June 29	2.10	173	December 13	2.95	306	June 30	3.20	110
July 2	2.10	175	December 17	2.95	331	July 3	3.25	123
July 6	2.10	192	December 20	3.00	346	July 7	3.20	98
July 9	2.05	165	December 24	2.95	326	July 10	3.25	118
July 11	2.05	167	December 27	2.95	309	July 14	3.30	130
July 13	2.10	210	December 31	2.95	315	July 17	3.85	380
July 16	2.30	241				July 21	4.40	480
July 18	2.15	196	1908.			July 22	4.20	376
July 20	2.00	144	January 3	3.00	358	July 24	4.00	325
July 23	2.15	166	January 7	3.00	353	July 28	7.10	3,860
July 25	2.60	426	January 10	2.95	299	July 31	5.20	1,180
July 27	2.50	320	January 14	3.00	313	August 4	4.80	690
July 30	2.40	275	January 17	2.95	296	August 7	6.00	2,230
August 1	2.50	280	January 21	2.95	293	August 14	5.10	992
August 3	2.75	566	January 24	2.95	292	August 17	4.65	638
August 6	3.50	830	January 28	2.95	285	August 21	5.75	1,290
August 8	2.90	487	January 31	3.00	336	August 25	4.40	471
August 10	2.70	338	February 4	9.10	14,400	August 28	4.80	703
August 13	2.45	236	February 6	5.40	3,590	September 1	4.25	364
August 15	2.35	239	February 8	4.10	1,430	September 4	4.20	364
August 17	2.25	200	February 11	3.95	1,080	September 8	4.15	317
August 20	2.60	316	February 13	4.00	1,260	September 11	5.20	893
August 22	2.40	280	February 15	3.85	795	September 15	4.40	395
August 24	2.50	320	February 18	3.90	970	September 18	4.20	291
August 27	2.55	288	February 20	3.90	959	September 22	4.15	230
August 29	2.50	267	February 22	3.80	808	September 25	4.60	469
August 31	2.60	355	February 25	4.80	1,910	September 29	4.10	223
September 2	2.90	438	February 27	4.20	1,350	October 2	4.10	220
September 4	3.00	449	March 3	4.50	1,550	October 6	4.10	210
September 6	3.90	1,220	March 5	4.15	1,160	October 9	4.10	207
September 10	3.30	563	March 7	6.35	4,370	October 13	4.10	187
September 12	2.90	422	March 9	4.70	1,540	October 16	4.05	175
September 14	2.75	352	March 11	4.30	962	October 20	4.70	498
September 17	2.85	362	March 13	4.05	784	October 23	4.50	306
September 19	2.55	275	March 17	4.35	1,010	October 27	4.45	295
September 21	2.50	244	March 20	4.35	1,000	October 30	4.40	261
September 24	2.40	192	March 24	3.95	519	November 4	4.40	268
September 26	2.50	225	March 27	3.85	478	November 6	4.40	269
October 1	2.40	193	March 31	3.75	405	November 10	4.45	274
October 3	2.45	207	April 3	3.75	408	November 13	4.45	286
October 5	2.55	297	April 7	3.65	346	November 17	4.45	276
October 9	3.05	552	April 10	3.55	302	November 20	4.45	283
October 11	2.85	327	April 14	3.50	266	November 24	4.50	307
October 15	2.90	424	April 17	3.45	253	November 27	4.50	282
October 17	3.05	462	April 21	3.40	196	December 1	4.65	327
October 19	4.20	1,650	April 24	3.55	316	December 4	5.10	592
October 22	3.30	590	April 28	3.55	311	December 8	5.10	587
October 24	3.80	993	May 1	3.50	255	December 11	4.85	355
October 25	4.30	1,560	May 5	3.50	259	December 15	4.95	453
October 29	3.50	702	May 8	5.60	2,030	December 16	19.20	[a] 60,000
October 31	3.15	468	May 12	4.25	507	December 17	10.30	12,000
November 2	3.20	557	May 15	3.90	333	December 19	6.25	3,400
November 5	3.05	451	May 19	3.70	233	December 22	5.15	1,310
November 7	2.95	368	May 22	3.10	210	December 24	5.00	905
November 9	2.90	364	May 26	3.50	192	December 29	4.55	595
November 12	2.85	321	May 29	3.40	169	December 31	4.45	507

[a] Float velocity.

Daily gage height, in feet, of Verde River at McDowell, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	6.30	8.65	3.05	3.45	2.40	2.35	2.10	2.40	3.07	2.40	3.02	2.95
2	5.35	6.50	3.50	3.42	2.35	2.32	2.10	2.28	2.90	2.40	3.20	2.95
3	4.45	5.60	4.37	4.85	2.38	2.28	2.10	2.85	2.80	2.45	3.15	2.95
4	4.25	5.40	4.70	4.28	2.40	2.28	2.08	4.50	2.90	2.48	3.05	2.95
5	4.20	5.20	6.10	4.22	2.35	2.28	2.05	3.70	3.45	2.55	3.05	2.95
6	4.30	5.25	13.35	4.05	2.30	2.28	2.10	3.40	3.90	2.75	3.00	2.95
7	4.30	5.30	9.05	3.75	2.30	2.25	2.10	3.10	3.65	2.95	2.95	2.95
8	4.25	4.75	6.40	3.50	2.32	2.20	2.10	2.90	3.48	3.18	2.95	2.95
9	4.60	4.00	5.25	3.30	2.30	2.30	2.05	2.80	3.32	3.05	2.90	2.95
10	5.90	3.50	4.45	3.12	2.32	2.25	2.05	2.68	3.22	2.88	2.90	2.95
11	6.95	3.28	5.05	3.02	2.30	2.20	2.05	2.56	3.00	2.82	2.90	2.95
12	7.62	3.08	4.12	2.98	2.28	2.25	2.10	2.45	2.87	2.75	2.85	2.95
13	6.10	2.88	3.85	2.90	2.25	2.25	2.10	2.42	2.77	2.78	2.85	2.95
14	4.95	2.75	3.45	2.84	2.25	2.25	2.12	2.38	2.75	2.82	2.85	2.95
15	4.25	2.70	3.38	2.78	2.25	2.20	2.15	2.35	3.20	2.95	2.90	2.95
16	3.90	2.62	3.20	2.68	2.25	2.20	2.25	2.30	3.00	2.88	2.90	2.95
17	3.60	2.68	3.20	2.60	2.28	2.20	2.18	2.25	2.80	3.02	2.90	2.95
18	3.50	2.60	3.00	2.55	2.25	2.20	2.15	2.20	2.57	3.38	2.95	2.95
19	3.70	4.50	2.95	2.50	2.25	2.20	2.08	2.35	2.52	4.15	3.00	2.95
20	3.60	3.45	3.05	2.50	2.25	2.20	2.00	2.52	2.57	3.75	3.00	3.00
21	3.42	2.95	3.20	2.48	2.28	2.20	2.08	2.40	2.50	3.45	3.05	2.95
22	3.45	2.70	3.32	2.45	2.25	2.20	2.12	2.38	2.45	3.28	3.00	2.95
23	3.32	4.02	6.70	2.45	2.25	2.18	2.18	2.55	2.40	3.20	3.00	2.95
24	3.35	6.75	5.60	2.45	2.22	2.15	2.10	2.50	2.40	3.90	2.98	2.95
25	3.35	4.70	4.35	2.40	2.20	2.15	2.65	2.58	2.40	4.40	2.95	2.95
26	3.25	3.50	3.85	2.40	2.20	2.15	2.60	2.62	2.45	4.30	2.95	2.95
27	3.20	2.95	3.70	2.40	2.20	2.15	2.48	2.52	2.40	3.90	2.95	2.95
28	3.28	2.85	3.80	2.38	2.22	2.12	2.44	2.42	2.45	3.65	2.95	2.95
29	3.30	.....	3.60	2.35	2.30	2.10	2.40	2.50	2.45	3.45	2.95	2.95
30	3.48	.....	3.50	2.40	2.35	2.10	2.38	3.32	2.45	3.25	2.95	2.95
31	9.80	.....	3.50	.....	2.35	.....	2.32	2.62	.....	3.12	.....	2.95
1908.												
1	2.95	3.00	4.45	3.75	3.50	3.35	3.20	4.85	4.22	4.10	4.40	4.62
2	2.95	3.00	4.75	3.75	3.50	3.35	3.25	4.68	4.28	4.10	4.40	4.60
3	3.00	3.12	4.45	3.75	3.50	3.35	3.20	4.40	4.22	4.10	4.40	4.75
4	2.95	9.10	4.30	3.70	3.48	3.38	3.20	4.78	4.20	4.10	4.40	5.30
5	2.95	7.90	4.52	3.70	3.50	3.40	3.20	5.37	4.20	4.10	4.40	5.30
6	3.00	5.30	8.35	3.70	3.58	3.35	3.20	6.30	4.20	4.10	4.40	5.25
7	3.00	4.50	5.95	3.65	5.95	3.35	3.20	5.85	4.15	4.10	4.40	5.20
8	3.00	4.05	5.35	3.60	5.58	3.35	3.20	5.48	4.18	4.10	4.40	5.05
9	2.98	4.10	4.75	3.58	5.10	3.35	3.25	5.32	4.40	4.10	4.42	4.90
10	2.95	4.10	4.55	3.55	4.65	3.35	3.25	4.85	4.60	4.10	4.45	4.88
11	2.95	3.95	4.32	3.55	4.28	3.35	3.40	4.98	5.10	4.10	4.45	4.85
12	2.95	3.90	4.18	3.50	4.25	3.35	3.30	4.98	4.80	4.10	4.45	4.80
13	2.98	4.00	4.02	3.50	4.12	3.35	3.25	4.98	4.60	4.10	4.45	4.80
14	3.00	3.90	3.95	3.50	3.98	3.30	3.30	5.20	4.48	4.10	4.50	4.80
15	2.98	3.85	4.05	3.45	3.90	3.30	3.62	4.82	4.35	4.08	4.50	5.32
16	2.95	3.95	4.18	3.45	3.85	3.30	3.65	4.30	4.28	4.05	4.45	17.65
17	2.95	4.00	4.38	3.45	3.80	3.25	3.85	4.58	4.22	4.10	4.45	11.25
18	2.95	3.92	4.48	3.45	3.72	3.30	3.92	4.68	4.20	4.60	4.45	7.65
19	2.95	3.95	4.48	3.40	3.68	3.30	5.00	4.68	4.20	4.75	4.48	6.12
20	2.95	3.85	4.35	3.40	3.60	3.30	4.50	4.50	4.20	4.68	4.45	5.60
21	2.95	3.82	4.30	3.40	3.60	3.30	4.35	5.42	4.18	4.60	4.50	5.35
22	2.95	3.75	4.15	3.40	3.60	3.28	4.18	5.15	4.15	4.55	4.50	5.15
23	2.95	4.75	3.98	3.50	3.55	3.25	4.05	5.30	4.10	4.50	4.50	5.02
24	2.95	5.60	3.92	3.55	3.50	3.25	3.98	5.30	4.15	4.45	4.50	4.98
25	2.95	4.70	3.85	3.60	3.50	3.25	4.22	4.40	4.52	4.40	4.50	4.88
26	2.95	4.12	3.85	3.60	3.50	3.25	3.38	4.65	4.20	4.42	4.50	4.78
27	2.98	4.20	3.85	3.58	3.50	3.25	5.02	4.88	4.20	4.45	4.50	4.68
28	2.95	4.30	3.80	3.55	3.45	3.25	6.15	4.72	4.18	4.45	4.55	4.60
29	2.95	4.30	3.75	3.52	3.40	3.22	5.20	4.55	4.10	4.42	4.60	4.58
30	2.98	.....	3.75	3.50	3.40	3.20	5.70	4.45	4.10	4.40	4.60	4.50
31	3.00	.....	3.75	.....	3.40	.....	5.15	4.30	.....	4.40	.....	4.45

Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3,550	10,200	1,630	1,150	330	270	173	280	370	193	430	315
2	2,090	4,500	2,000	1,060	292	260	173	200	438	193	557	315
3	1,760	3,150	3,080	3,100	300	248	173	640	350	207	510	315
4	1,570	3,000	3,550	2,220	321	240	173	2,100	390	230	450	330
5	1,560	2,810	5,670	2,170	290	230	170	1,040	740	297	450	340
6	1,730	2,860	32,200	1,940	257	220	192	740	1,220	380	420	350
7	1,800	3,370	11,400	1,530	260	220	190	570	920	410	368	340
8	1,750	2,910	6,350	1,260	270	213	170	487	730	690	368	330
9	1,920	2,080	4,760	1,060	271	240	165	410	570	552	364	330
10	3,630	1,640	3,360	860	270	220	165	340	510	390	364	322
11	5,260	1,530	4,100	760	245	212	167	270	420	310	364	320
12	6,450	1,500	2,490	710	240	220	200	240	410	290	321	310
13	4,130	1,300	1,990	639	224	226	210	230	360	310	321	306
14	2,490	1,140	1,570	610	230	220	220	230	352	350	321	310
15	1,730	1,100	1,500	570	232	197	230	239	600	400	366	320
16	1,390	920	1,380	510	230	197	241	220	450	350	366	330
17	1,160	880	1,230	462	260	198	230	206	330	430	366	331
18	1,130	610	980	430	240	198	196	460	280	730	370	330
19	1,400	3,120	896	403	230	200	170	210	270	1,570	380	340
20	1,320	1,780	980	400	230	211	144	280	270	980	380	346
21	1,240	1,370	1,130	370	240	200	150	280	244	680	393	326
22	1,260	1,280	1,240	330	230	191	160	280	220	580	370	326
23	1,180	3,020	7,120	327	226	185	170	300	192	580	370	326
24	1,180	8,040	4,620	320	220	178	170	320	200	1,120	350	326
25	1,180	4,000	2,420	300	208	180	470	300	200	1,730	330	320
26	1,180	2,020	1,790	293	210	180	420	310	220	1,560	325	310
27	1,200	1,690	1,600	390	220	186	320	280	200	1,100	325	309
28	1,220	1,510	1,770	340	230	180	300	230	220	820	320	310
29	1,230	.....	1,510	300	240	173	280	267	220	640	319	312
30	1,420	.....	1,230	330	270	173	270	1,020	220	510	318	315
31	15,200	.....	1,230	.....	274	.....	270	360	.....	460	.....	315
1908.												
1	300	336	1,500	405	255	140	110	690	364	221	264	327
2	300	336	2,200	407	255	140	125	580	380	220	265	310
3	358	400	1,550	408	255	139	120	440	370	218	267	350
4	300	14,400	1,280	405	250	150	110	640	364	215	268	800
5	300	9,800	1,600	400	259	179	110	1,400	360	212	268	800
6	350	3,400	11,000	400	280	163	100	2,600	350	210	269	740
7	353	2,000	3,500	346	2,410	163	98	2,230	310	209	270	680
8	350	1,430	2,450	320	2,030	163	100	1,420	317	208	270	500
9	330	1,400	1,540	310	1,360	163	115	1,330	450	207	270	450
10	299	1,200	1,330	302	850	163	118	780	560	202	274	420
11	300	1,080	962	300	550	163	170	860	880	197	278	400
12	300	1,000	880	270	507	163	130	860	620	192	282	380
13	310	1,260	780	270	430	163	120	860	510	187	286	380
14	313	1,000	720	266	360	151	130	992	400	185	280	380
15	310	795	784	260	333	151	270	740	380	180	280	840
16	300	1,000	880	255	310	151	300	420	340	175	280	51,600
17	296	1,100	1,010	253	290	140	380	600	310	200	276	17,000
18	295	970	1,170	250	250	150	400	650	291	450	280	5,600
19	295	1,000	1,160	200	233	150	1,020	650	290	520	280	3,400
20	295	959	1,000	200	210	150	650	570	290	495	283	2,200
21	293	900	970	196	210	150	480	1,080	250	410	290	1,700
22	293	808	760	200	210	140	376	920	230	360	295	1,310
23	293	810	570	280	200	131	350	1,000	210	306	300	1,000
24	292	3,000	519	316	200	130	325	1,000	230	290	307	905
25	290	1,910	480	330	195	130	400	471	430	270	300	820
26	290	1,300	480	330	192	123	200	590	260	280	290	750
27	300	1,350	478	320	190	120	1,020	750	260	295	282	680
28	285	1,130	470	311	180	120	2,350	703	240	290	290	620
29	285	1,130	420	270	169	120	1,200	570	223	280	300	600
30	290	.....	410	255	160	110	1,780	500	223	261	300	540
31	336	.....	405	.....	160	.....	1,180	380	.....	262	.....	507

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Verde River at McDowell, Ariz., for 1907 and 1908.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1907.						
January	a 18,000	1,130	2,430	0.405	0.47	149,000
February	a 11,300	610	2,620	.437	.46	146,000
March	a 38,200	896	3,770	.628	.72	232,000
April	3,100	293	838	.140	.16	49,900
May	330	208	251	.042	.05	15,400
June	270	173	209	.035	.04	12,400
July	470	144	217	.036	.04	13,300
August	2,100	200	430	.072	.08	26,400
September	1,220	192	404	.067	.08	24,000
October	1,730	193	614	.102	.12	37,800
November	557	318	375	.062	.07	22,300
December	350	306	323	.054	.06	19,900
The year	38,200	144	1,040	173	2.34	748,000
1908.						
January	358	285	306	.051	.06	18,800
February	a 15,600	336	1,970	.328	.35	113,000
March	a 13,000	405	1,400	.233	.27	86,100
April	408	196	301	.050	.06	17,900
May	a 2,600	160	443	.074	.09	27,200
June	179	110	146	.024	.03	8,690
July	a 3,860	98	463	.077	.09	28,500
August	a 2,800	380	880	.147	.17	54,100
September	a 893	210	356	.059	.07	21,200
October	a 600	175	265	.044	.05	16,300
November	307	264	281	.047	.05	16,700
December	a 60,000	310	3,130	.522	.60	192,000
The year	60,000	98	828	.138	1.89	600,000

a Maximum discharge recorded during the month. These occurred in 1907 on January 31, February 1, March 6; and in 1908 on February 4, March 6, May 7, July 28, August 6, September 11, October 19, and December 16.

MISCELLANEOUS MEASUREMENTS IN GREEN RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in Green River drainage basin during 1908:

Measurements in Green River basin, 1908.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
July 28, 1908	East Fork of Lake Fork.	Duchesne River	Above forks near Whiterocks, Utah.	.....	289
July 29, 1908	West Fork of Lake Fork.	do	At lakes, 12 miles above forks near Whiterocks, Utah.	a 2.20	252
July 30, 1908	Rock Creek	do	Below Stillwater Lake, Wasatch County, Utah.	.....	258

a At gage used in 1904, see Water-Supply Paper 133, p. 124.

MISCELLANEOUS MEASUREMENTS IN GRAND RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in Grand River drainage basin during 1906, 1907, and 1908:

Miscellaneous measurements in Green River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Nov. 30, 1908	Grand River	Colorado River	Dotsero, Colo		429
Oct. 2, 1907	East Inlet Grand Lake.	Grand Lake	Grand Lake, Colo		14.5
July 3, 1908	do	do	do	[a] 4.0	116
Aug. 19, 1908	Willow Creek	Grand River	At mouth, near Granby, Colo.	[b] 3.20	33
Sept. 18, 1908	do	do	do	[b] 2.95	14
June 20, 1907	Williams Fork	do	Above South Fork	3.0	[c] 1,070
July 18, 1907	do	do	do	1.4	93
Oct. 13, 1907	do	do	do	.8	25
June 20, 1907	do	do	Below South Fork	4.0	[c] 1,720
July 20, 1907	do	do	do	1.4	262
Oct. 12, 1907	do	do	do	.4	50
June 20, 1907	South Fork of Williams Fork.	Williams Fork		4.5	[c] 548
July 20, 1907	do	do		2.4	103
Oct. 13, 1907	do	do		1.6	19
June 20, 1907	Bobtail Creek	do		3.0	[c] 880
July 17, 1907	do	do		1.2	60
Oct. 11, 1907	do	do		.7	9
June 20, 1907	Steelman Creek	do		2.5	[c] 335
July 17, 1907	do	do		1.0	30
Oct. 12, 1907	do	do		.4	5
June 20, 1907	McQueary Creek	do		1.5	[c] 75
July 18, 1907	do	do		.5	15
Oct. 12, 1907	do	do		.2	2
Nov. 20, 1907	Snake Creek	Blue River	6 miles above junction with Blue River, near Dillon, Colo.		21.5
Feb. 12, 1908	do	do	do		11.1
Apr. 15, 1908	do	do	do		33.8
Apr. 17, 1908	do	do	do		21.9
Aug. 21, 1908	do	do	do		70
Nov. 22, 1907	Straight Creek	do	4 miles above mouth, near Dillon, Colo.		4.1
July 22, 1908	Piney River	Grand River	At mouth, near Radium, Colo.		[d] 35
Apr. 5, 1906 [e]	Gypsum Creek	Eagle River	Gypsum, Colo		44
May 3, 1906 [e]	do	do	do		44
June 16, 1906 [e]	do	do	do		50
May 28, 1906 [e]	do	do	do		37
June 8, 1907	do	do	do		[d] 20
Aug. 20, 1907	do	do	do		[d] 18
July 21, 1908	do	do	do		[d] 4
Aug. 22, 1908	do	do	do		[d] 10
Sept. 22, 1908	do	do	do		[d] 24
Oct. 26, 1908	do	do	do		45
Nov. 29, 1908	do	do	do		40
July 20, 1908	No Name Creek	Grand River	3 miles above Glenwood Springs, Colo.		[d] 4
Dec. 19, 1907	Roaring Fork	do	Above Frying Pan River near Basalt, Colo.		159
Feb. 13, 1908	do	do	do		137
Aug. 27, 1908	Sopris Creek	Roaring Fork	Emma, Colo		[d] 6
Sept. 25, 1908	do	do	do		[f] 14.9
Oct. 29, 1908	do	do	do		[d] 15
Dec. 2, 1908	do	do	do		[d] 10
Dec. 20, 1907	Crystal River	do	Carbondale, Colo		93
Feb. 12, 1908	do	do	1 mile west of Carbondale, Colo.		100
Feb. 29, 1908	do	do	do	.30	90
Apr. 1, 1908	do	do	do	.35	120
Apr. 4, 1908	do	do	do	.45	124
Mar. 29, 1908	Yule Creek	Crystal River	Marble, Colo		6

[a] Below head of spike in overhanging pine tree on right bank 200 feet above mouth.
[b] Nail in upstream end of center cross beam of wooden road bridge ½ mile above mouth, taken as elevation 9.00 feet.
[c] Discharge estimated from high-water marks by Kutter's formula, discharges and dates approximate.
[d] Discharge estimated.
[e] Not published in Water-Supply Paper 211.
[f] Float measurement.

Miscellaneous measurements in Green River basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Dec. 3, 1908	Nettle Creek	Crystal River	Sewell, near Carbondale, Colo.		[a] 3
July 18, 1908	Thompson Creek	do	do	.57	6.6
Aug. 25, 1908	do	do	do	.68	10.2
Sept. 24, 1908	do	do	do		[a] .5
Oct. 30, 1908	do	do	do	.60	11.2
Dec. 3, 1908	do	do	do		[a] 8.0
July 18, 1908	Thompsons ditch	Thompson Creek	do		[a] 1.5
July 18, 1908	Sewells ditch	Diverts from Thompson Creek.	do		[a] 1.0
July 18, 1908	Pioneer ditch	do	do		[b] 13.8
Aug. 25, 1908	do	do	do		[a] 0.15
Sept. 24, 1908	do	do	do		[b] 6.2
Oct. 30, 1908	do	do	do		[a] 0.75
July 18, 1908	Sweet ditch	Diverts from Crystal River.	do		[b] 15
Aug. 25, 1908	do	do	do		[b] 15.9
Sept. 24, 1908	do	do	do		[b] 8.0
Oct. 30, 1908	do	do	do		[a] 1.2
Dec. 3, 1908	do	do	do		0
July 18, 1908	Big Four ditch	do	do		[a] 8
Aug. 25, 1908	do	do	do		7.6
Sept. 24, 1908	do	do	do		3.6
Oct. 30, 1908	do	do	do		1.8
July 18, 1908	Grubb ditch	do	do		[a] 12
Aug. 25, 1908	do	do	do		[b] 12.8
Sept. 24, 1908	do	do	do		[b] 16
Oct. 30, 1908	do	do	do		[a] 1.5
Dec. 3, 1908	do	do	do		[a] 1.5

[a] Discharge estimated. [b] Float measurement.

NOTE.—The measurements of Williams Fork and its tributaries were made by A. L. Fellows and H. F. Fellows in connection with an investigation of water supply for the Intermountain Water Company.

MISCELLANEOUS MEASUREMENTS IN VIRGIN RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in Virgin River drainage basin during 1908:

Miscellaneous measurements of Muddy River in Virgin River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
May 20, 1908	Muddy River	Virgin River	Near Moapa, Nev.	1.70	46.0
June 2, 1908	do	do	do	1.60	40.5
Oct. 10, 1908	do	do	do	1.50	44.8
Dec. 4, 1908	do	do	do	1.67	53.8

NOTE.—The gage heights were taken at the gaging station on Muddy River near Moapa, Nev.

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